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ABSTRACT

Intended as an instructional guide for the use of a science teacher or beauty culture shop teacher in teaching the scientific aspects in a 1-year prevocational cosmetology program at area vocational high schools, this state curriculum guide was developed by a committee of vocational instructors and field tested in three vocational schools. An introductory course rationale precedes 11 topical units, which focus on the following areas: (1) hygiene and sanitation, (2) microscopic organisms, (3) the human body, (4) the skin, (5) the hair and scalp, (6) the nail, (7) the chemistry of hair products, (8) chemistry of tints and bleaches, (9) chemistry of cosmetics, (10) electricity in the salon, and (11) light in the salon. Important teaching points are summarized, review questions are presented, and learning activities are given for each of the 11 instructional units. Glossaries, reading materials, and numerous line diagrams enrich the text. (AG)

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THE RELATED SCIENCE OF COSMETOLOGY

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TABLE OF CONTENTS

Page

Foreword to the Teacher i

Introduction to Cosmetology 1

UNIT I – Hygiene and Sanitation 3

Personal Hygiene. . . Vitamin Wheel. . . Public Hygiene. Sanitation

UNIT II – The Unseen World 7

Microscopic Organisms . . . Fungi . . . Yeasts . . . Molds . . . Bacteria . . . Infectious Diseases . . . Sterilization . . . First Aid

UNIT III – The Human Body 20

Introduction. . . Cells. . . Tissues. . .Organs. . . Systems of the Body. . .Skeletal System. . .Muscular System. . . Nervous System. . . Circulatory System. . . Endocrine System. . . Respiratory System. . . Digestive System. . . Excretory System

UNIT IV – The Skin 71

Structure and Functions of the Skin. . . Common Skin Problems . . Skin Diseases

UNIT V – The Hair and Scalp 81

Composition of Hair. . .Hair Problems. . . Scalp Disorders. . . Scalp Diseases

UNIT VI – The Nail 95

Composition of the Nail. . . Disorders of the Nail

UNIT VII – The Chemistry of Hair Products 98

Introduction to Basic Chemistry. . . How Cold Wave Solutions Work. . . Acids, Alkalies, and Salts. . . Mixtures. . . Strength of Solutions. . . Chemistry of Soaps and Shampoos. . . Hard Water

Page

UNIT VIII – Chemistry of Tints and Bleaches 116

Bleaches. . . Penetrating Tints. . . Coating Tints

UNIT IX – Chemistry of Cosmetics 123

Classes of Cosmetics. . . Formulas for Experiments

UNIT X – Electricity in the Salon 128

What Is Electricity? . . Circuits. . . Electrical Therapy. . .
Safety. . . Static Electricity

UNIT XI – Light in the Salon 134

What is Light? . . Color. . . Infra-Red Treatments. . .
Ultraviolet Treatments

Foreword to the Teacher

An effort has been made during the preparation of this text to meet three considerations found to be important in the experience of this writer.

1. The belief that the Related Science of Beauty Culture is an important factor in producing a complete, well-rounded cosmetologist and should be considered important by the teacher.

2. The hope that the sciences associated with Beauty Culture can be an interesting and pleasant experience to students who admittedly prefer the practical-application side of their course of study.

3. The belief that combining the theory of the physical practice of beauty culture into the same text with related science information is not a wise method and often leads to confusion.

As a direct result of these feelings on the part of the author, the teacher will note that this book is strictly limited to related science. The practical study of beauty culture and its applications are left to other texts.

The goals of the author should be elaborated upon: The importance of the first goal should be obvious to the teacher and student. It may be stated that every practical phase of beauty culture has an organized body of knowledge behind it, which if learned will help the person perform more efficiently. For example, if one learns the proper application of hair tints, face creams, or permanent wave solutions, then one should also be aware of some of the chemicals used in the making of these products. This knowledge will help a student to understand the reaction of such chemicals on the patron's hair and skin, and the reasons behind the precautions for their use. In this way the cosmetologist's broad understanding of the field is increased.

In addition, hair stylists, however talented, will not satisfy large segments of our affluent society if they cannot (a) show a broad knowledge of their field, and (b) be able to articulate their ideas to their patrons in a mature and intelligent manner. Increasingly, cosmetology has become a competitive field in which success may depend upon *knowing* as well as *performing* better than the next individual.

The second goal is of personal interest to this writer. As an instructor who has been privileged to witness the thrill of a learning experience upon the face of a high school youngster, I am convinced that creativity on the part of the teacher is a key to the learning experience. Therefore, this is not a text designed solely to state a body of knowledge. Rather, it is an effort to develop creative concepts for use in the learning experience. The teacher is urged to try the learning techniques suggested as study aids at the end of most units. The student is also urged to join in what hopefully will be a pleasurable learning time.

One further note on the use of terms: It is this writer's belief that it is not wise to place too much emphasis on the meaning of the words cosmetologist, or beautician, or hairdresser, etc., etc. An operator in the beauty profession is known by many titles and most are acceptable. These terms will be used interchangeably throughout the book and the student should become familiar with the complete terminology of his profession.

The Author

INTRODUCTION TO COSMETOLOGY

Salon Ethics

How should a beautician speak to a patron? How should a hairdresser behave toward the manager of a beauty salon? If you, as a student, can answer these questions, you probably already know what "salon ethics" means. Ethics involve *the manner in which you conduct yourself in the salon.* Today's beauty salon patron spends a good deal of time and money in the salon. She will probably object to the following types of behavior:

1. An operator who talks too much.
2. An operator who is insulting while attempting to give advice.
3. An operator who chooses to talk about religion.
4. An operator who insists on discussing other patrons.

Have you ever watched a hairdresser who was guilty of these violations?

It is important for hairdressers in a salon to get along with each other. A good relationship is a practical help as well as making for pleasant working conditions. For example:

1. If you are sick, you will want someone to accommodate your patrons.
2. If you run out of materials you might want to borrow some from someone else.
3. A friendly atmosphere makes for satisfied patrons.

Ethics also involves your relationship with your employer. Some common problems are:

1. The manager may have a different type of personality from your own.
2. You might consider the manager too harsh or "pushy" towards you.

Can you answer this?

Which one of the problems previously mentioned do you recognize?

1. Mrs. Brown asks for advice on how to apply makeup to her nose and eye area. Her operator starts the reply with, "Mrs. Brown, since you have a very long nose and small, beady eyes, I would suggest you etc., etc..."
2. The operator asks Mrs. Johnson, "Do you go to church much?"

Assignments and Study Aids

Home –

Each student should write a paragraph describing the proper way to handle the above situations.

Class –

Two volunteers should be asked to act out the roles of Mrs. Brown and her operator. This is called role-playing. The student who plays the part of the operator should repeat the words written above to the student who is playing the part of Mrs. Brown. Mrs. Brown may answer as she sees fit.Discuss how Mrs. Brown should be spoken to, even if she has unattractive features. Volunteers should be asked to attempt an answer to Mrs. Brown.

UNIT I – HYGIENE AND SANITATION

"Hygiene" may be defined as the science of healthful living. We say there are two types of hygiene, personal hygiene and public hygiene.

Personal Hygiene

As you can tell from the word "personal," this kind of hygiene refers to the care of your own body. Of course all persons should have clean and well-cared-for bodies, but it is particularly important for beauty operators to maintain good health practices. Here are two reasons why:

1. Due to your close personal contact with patrons, it is very easy to spread germs.
2. When sickness strikes a cosmetologist, it usually results in loss of basic pay, tips, and commissions. (Later in the text we will learn how to keep free from germs and as a result free from unnecessary illness.)

Here are some easy rules which, if followed, will help us to maintain good personal health.

1. **Food.**–A well-balanced diet consists of the right amounts of *protein* (meat, fish, eggs), *carbohydrates* (bread, potatoes, cereals), *fats* (butter, milk, bacon), *mineral matter* (salt, liver, spinach), and *water*. Water is very important. This precious liquid has the ability to **help** us digest foods and in general promotes a healthy body system. Without the proper foods, all the beauty treatments in the world will not make us look or feel our best.

2. **Exercise.**–This will stimulate digestion of food, help to circulate blood, and keep our muscles fit.

3. **Sunshine.**–Sunshine builds healthy bones, fights disease germs, and helps to provide healthy-looking complexions.

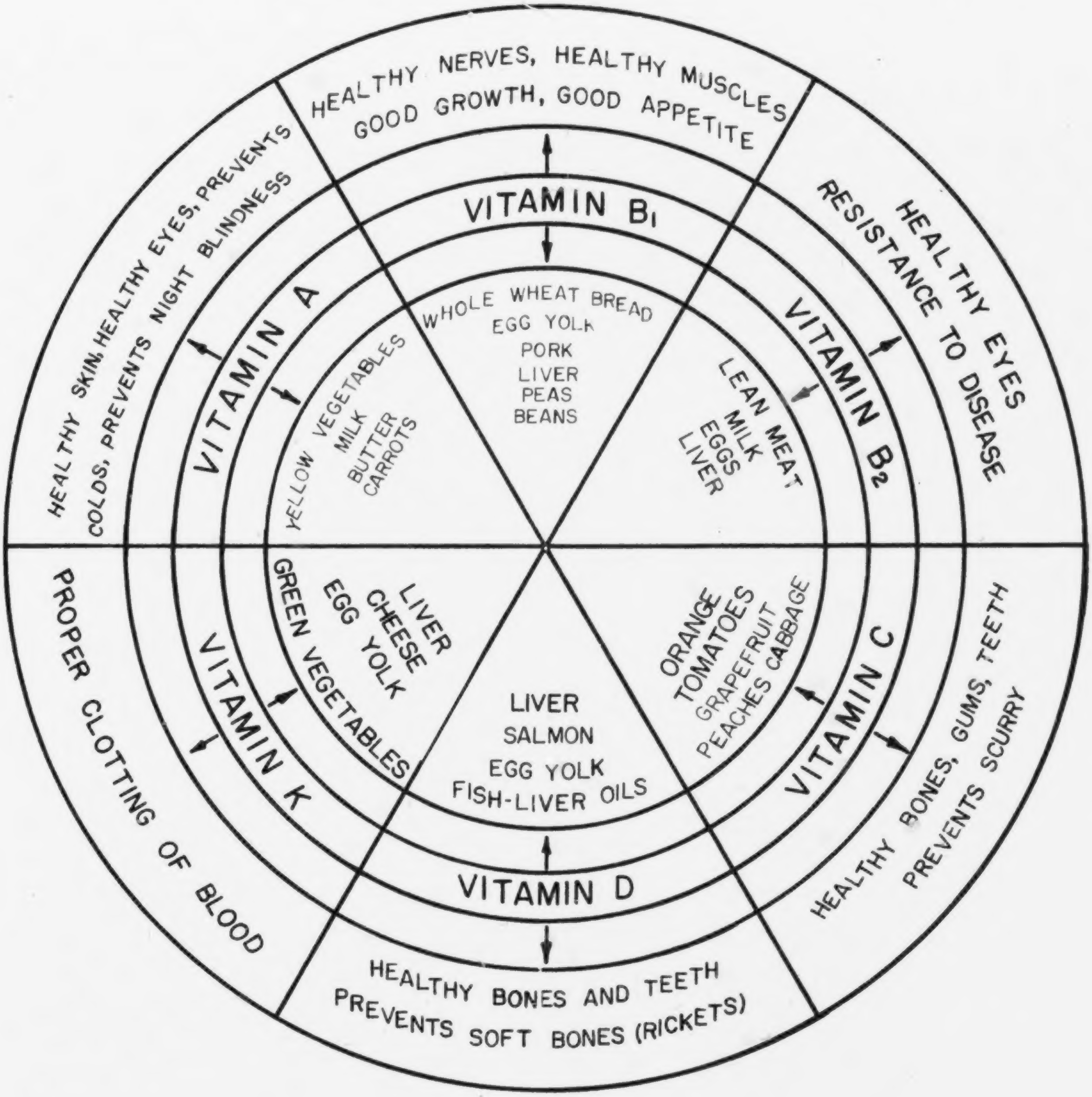
4. **Rest and sleep.**–Proper amounts of rest and sleep allow our tissues and organs to recover from their hard work.

5. **Cleanliness.**–Proper use of soap and water will remove unhealthy waste materials from the surface of our skin. Our skin will be clean and fresh and we will look better.

Deodorants and antiperspirants also help to make us more aceptable to others, especially with the close contact necessary in beauty culture.

In connection with food, we know that certain vitamins are valuable in keeping our good health. The chart below shows the connection between vitamins and good health.

THE VITAMIN WHEEL



Public Hygiene

No matter how clean you may keep yourself, there are certain things you simply cannot do for yourself. For example, you can put your garbage into closed containers, but what happens when the containers are filled? Someone must cart the garbage away for you. You might try to avoid contagious diseases, but you cannot run away from people. For this reason it is best to be protected with inoculations, vaccines, and the like. When a town collects its garbage, when local government offers inoculations against disease, when the Federal government sets up a public health service, all are practicing public hygiene. *Public hygiene is the steps that government takes for the protection of the health of its people.* Your town has local health rules that you as an individual operator must follow. Learn what your town's rules are and obey them.

Summary

1. **Personal hygiene** means the care of our own bodies.
2. **Public hygiene** means the steps government takes for the health of its people.
3. In order to practice good personal hygiene we should
    a. Eat healthful foods.
    b. Exercise daily.
    c. Receive sunshine.
    d. Get rest and sleep.
    e. Practice body cleanliness

Can you answer this?

1. Define personal hygiene. Why should a beautician practice good personal hygiene?
2. In what ways do your local, state and Federal governments contribute to your good health?

Study Aids

Home –

Students should prepare reports of common health problems existing in today's big cities. For example, air and water pollution, rats, contagious diseases, etc., etc.

Class –

Oral reports may be given or group discussions may be held on how to contribute to the solution of these problems.

Sanitation

Following is a list of sanitary rules to be observed in the beauty salon.

1. No eating is permitted in working areas.
2. A freshly laundered towel must be used for each patron.
3. Floors should be swept frequently, and all cuttings should be put into closed containers.
4. Headrests and neckstrips must be changed for each patron.
5. The use of the same powder puff, lipstick, rouge, stypic pencil, etc., etc., by more than one person must not be permitted.
6. Implements dropped on the floor must be sterilized before they may be used on patrons.
7. Operators must wash hands before leaving the washroom.
8. Operators' uniforms should be laundered as often as necessary.
9. The beauty shop must be well lighted and ventilated.
10. Hairpins must not be placed in the mouths of operators.
11. Hair pins, combs, rollers, etc. should not be placed in the uniform pockets of the operators.
12. Once sterilized, all linens and instruments should be placed in dry sanitizers.

Study Aids

Home –

Students should pick out several of the sanitary rules and list all the reasons they can find for each of these rules.

Class –

As an aid in discussion, the reasons behind each rule should be presented by a different student.

UNIT II – THE UNSEEN WORLD

Microscopic Organisms

As early as the 17th century man was aware of tiny plants and animals which cannot be seen with the naked eye, but may be watched under a microscope. These tiny things carry on all the functions of life. An *organism* is any living thing. A microscopic organism (micro-organism) is a living thing that is so small that it can only be seen by means of a microscope.

Fungi (singular, fungus)

All the tiny, simple plants that do not contain the green coloring matter called chlorophyll are grouped into a large group called *fungi.* Some are easily seen, like the molds, mildews, rusts, smuts, and mushrooms. Some are much smaller, and can only be seen under a microscope, like the yeasts and the bacteria. These micro-organisms are all around us – in the air, water, earth, on foods – indeed on and in every living thing and dead thing.

All of these plants have something in common. Not having chlorophyll to enable them to make food from water and carbon dioxide, they must get their food in some other way. They get it from the things they are living on. Anything that gets its food from living tissue is called a *parasite*. Many molds, other fungi, and bacteria are parasites. Anything that gets its food from dead tissue is called a *saprophyte.* Many more molds, other fungi, and bacteria are saprophytes.

Although people tend to think of all of these simple plants as harmful, by far the greatest number of them are either harmless or actually beneficial to man.

Yeasts

We use yeasts to make bread dough rise, to ferment fruit juices into apple cider and wine. And yeasts are what make it possible to convert such things as grains, berries, corn, and potatoes into beer, whiskey, gin,and so on.

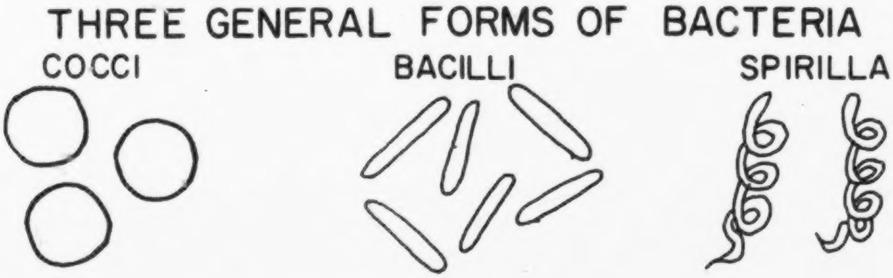
Molds

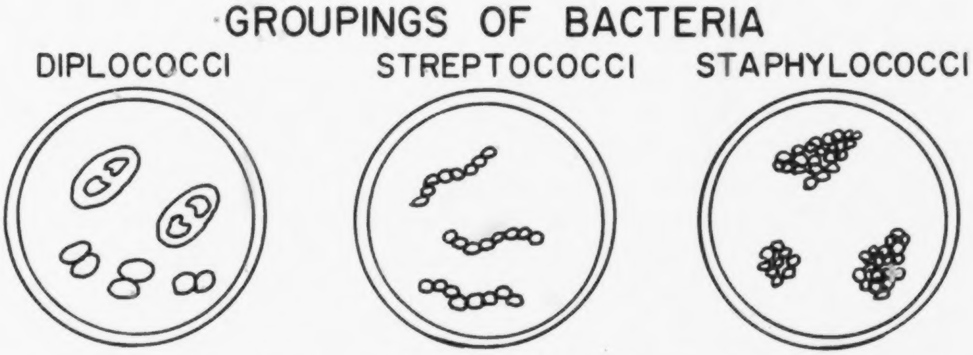
Mold plants are thought of usually as spoiling foods. But penicillin and other antibiotic lifesavers are made from molds. Molds give flavor to certain cheeses. And mushrooms are mighty good to eat (that is, the edible kinds!).

Bacteria

Bacteria make it possible for us to live on this earth. The *saprophytic* bacteria break down dead plants and animals, changing them to simple materials that plants can use to grow on and feed animals – including you and me. Without these bacteria, dead animals and plants would pile up and make life unbearable. There are also bacteria that take free nitrogen out of the air and change it into forms that plants can use. Other "good" bacteria ripen certain cheeses for us and make "cultured" milk products like yogurt.

There are a great many kinds of bacteria, but practically all come in one of three shapes, as shown here:





Notice that the three main types of bacteria are called cocci, bacilli, and spirilla. Cocci are always round-shaped, bacilli are rod- or stick-shaped, and spirilla are corkscrew-shaped. When cocci are in a chain-like arrangement they are called streptococci, when in a group or cluster they are called staphylococci and when in pairs they are called diplococci.

Although the beneficial bacteria greatly outnumber the harmful bacteria, we are naturally most interested in the harmful ones, for they are the ones that cause diseases. Any organism that can cause a disease is called *pathogenic*. Any organism that cannot cause a disease is called *nonpathogenic*.

The popular name for pathogenic bacteria, molds, and other fungi is *germ*. We speak of certain diseases as being caused by germs. Such diseases are called *infectious diseases*. (You get an *infection*.)

Here is a chart showing some of the diseases caused by bacteria.

Classes of Pathogenic Bacteria
Parasites

Cocci (round)	**Bacilli** (rod–shaped)	**Spirilla** (corkscrew shaped)
staphylococci streptococci diplococci		
Cause:	**Cause:**	**Cause:**
abscesses pustules boils blood poisoning pneumonia	influenza typhoid tuberculosis diphtheria tetanus	syphilis

Infectious Diseases

Not all diseases are caused by these plant-type parasites, however. Some diseases are caused by microscopic animals, called *protozoa.* Still others are caused by *viruses,* which are so small that they cannot be seen under an ordinary microscope, and must be viewed by an electron microscope.

Viruses do not appear to be living organisms like bacteria, fungi, and the others. They are like very complicated bits of protein that can grow and multiply only in living cells. So they are all parasitic, and they are all pathogenic.

Then there are diseases caused by tiny animal parasites. These insects, such as the louse or itch-mite, gather in the hundreds and may spread from the infected person to anyone who happens to be nearby.

Below is a list of some of the diseases caused by parasitic organisms of various sorts.

Parasite	**Diseases Caused**
Bacteria(plants)	pneumonia, tuberculosis, typhoid fever, strep throat, plague, cholera, diphtheria, lockjaw, dysentery, impetigo, syphilis, gonorrhea, whooping cough, and many more
Viruses	small pox, chicken pox, measles, rabies, poliomyelitis (polio), yellow fever, mumps, common cold, influenza, some cancers
Fungi (plants)	ringworm, athlete's foot
Protozoa (animals)	African sleeping sickness, malaria, dysentery
Parasitic worms	tapeworm, hookworm, trichinosis
Lice	pediculosis
Itch-mites	scabies

In most cases the laws of your State forbid you to work on individuals who have the above diseases. If you are not sure whether or not a person has such as disease, it is best not to take chances. In some cases the patron may be asked in a respectful manner whether she has already visited a physician about her symptoms. Always avoid saying things which might embarrass the patron, but remember that it is your duty to protect yourself and your other patrons.

Summary

1. There are many plants and animals which can only be seen with the aid of a microscope. They are called microscopic organisms.
2. Fungi are small, simple plants that depend for their food on the things they are living on.
3. Fungi include microscopic plants like yeasts and bacteria, and also visible plants like molds, mildews, and mushrooms.
4. Parasites get their food from living tissue. Saprophytes get their food from dead tissue. In general, parasites are harmful and saprophytes are not.
5. Bacteria and other fungi can be either pathogenic or nonpathogenic.
6. Bacteria come in three shapes – cocci, bacilli, spirilla.
7. Diseases may also be caused by protozoa and viruses.
8. Animal parasites such as the louse and itch-mite are also disease–producing.
9. Infectious diseases are diseases caused by an organism.

Study Aids

Home –

Reports may be prepared. Students should be familiar with the symptoms of the infectious diseases mentioned in this unit. Students should find out the difference between "infectious" and "contagious."

Class –

Would you like to observe bacteria growing? Then volunteer for the following experiment to be done in class.

EXPERIMENT

Objective: To view the growth of bacteria.

Materials: Beef broth, gelatin, Bunsen burner or propane torch, petri dish (or any flat glass saucer plus loose glass cover), food or water or milk.

Procedure: Mix gelatin with beef broth. Heat and pour into petri dish. Sterilize by heating with steam. This will kill any microscopic life present. Allow to cool and solidify. Now expose mixture to food, water, or milk as you prefer. Next, store mixture in a dark, warm place for several days. This is called incubation. Bacteria will multiply and form separate colonies which can be seen with the naked eye. (Look for small creamy masses.)

Can you answer this?

1. What are the types of fungi?
2. What is a parasite? Are parasites generally helpful or harmful to man?
3. What is a saprophyte? Are saprophytes generally helpful or harmful to man?
4. What are the shapes of bacteria?
5. What does "pathogenic" mean?
6. Tell about one useful type of bacterium; mold; yeast.
7. Name five different types of things that can cause infection in man.
8. Which germ causes tuberculosis? Which causes syphilis?
9. Name one animal parasite. What disease does it cause?
10. Which of these diseases is infectious? contagious? both?
    Measles, common cold, tetanus, syphilis, sickle-cell anemia, scabies, trichinosis, hemophilia, food poisoning, athlete's foot

Sterilization

After our discussion of bacteria, it is not hard to understand why we would want to kill these germs before they have a chance to do harm.

There are two basic methods of destrying germs in the beauty salon: physical means and chemical means.

Physical Methods of Destroying Germs

1. **Dry heat.** –In this method, an oven set at about 170 degrees centigrade will destroy all organisms.

2. **Boiling water.**–Water boils at 212 degrees Fahrenheit. A 20-minute treatment of implements will destroy germs.

3. **Steam under pressure.**–A device called an autoclave is used for keeping steam under pressure. This is a powerful method of killing germs.

In the salon it is impractical to use ovens or boiling water to sterilize implements. Ovens are too large, expensive, and unsightly. Boiling water is unwieldy and time-consuming. Steam under pressure is expensive and time-consuming. We can therefore say that physical methods of sterilization are not suitable for the salon.

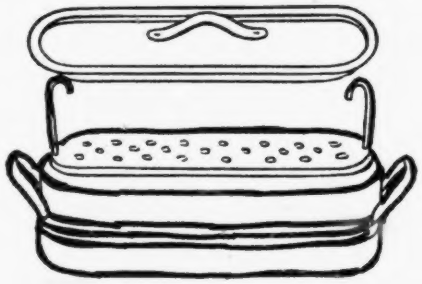
NOTE – Ultraviolet rays in electrical sanitizers may be used to keep implements germ-free, but only *after* they have first been sterilized.

Chemical Methods of Destroying Germs.

Disinfectants are chemicals used in the destruction of disease-causing germs. Most state boards of cosmetology recommend the following types of disinfectants:

1. Formaldehyde gas in water
2. Quaternary ammonium compounds
3. Alcohol
4. Commercial disinfectants such as Lysol, etc.

NOTE – The wet sterilizer in your school shop probably contains one of these types of chemicals.



Wet Sterilizer

Formaldehyde

Chemists know we cannot use formaldehyde, a gas, all by itself to kill germs. Instead chemists have come up with a chemical solution. The formaldehyde gas is mixed with water. When the gas and the water mix, we call the resulting mixture *formalin.* Formalin is an excellent disinfectant. When we purchase formalin we actually buy a 40% solution. Do not worry about the term "40% solution" now. Just accept it. Later in the text we will learn what percentages and solutions are. At this moment we are ready to use our 40% solution – or are we? As a matter of fact we are not. We must now mix our formalin with water, much as the company did in mixing formaldehyde gas with water. Actually you can use as much or as little formalin in water as you wish; it is used in different strengths for different purposes. Look at the chart below:

To get a formaldehyde solution of:	Use:	
1%	1 part formalin,	39 parts water
2%	2 parts formalin,	38 parts water
3%	3 parts formalin,	37 parts water
4%	4 parts formalin,	36 parts water
5%	5 parts formalin,	35 parts water
10%	10 parts formalin,	30 parts water

In all of the above strengths of formalin solutions, what is your key for remembering the portions? Look them over carefully and find the key number. Did you find the number 40? They each add up to 40.

NOTE – You just have to accept at this point: When we use only one part of formalin to 39 parts of water we have mixed a 1% solution of formaldehyde in water. When we mix 10 parts of formalin and 30 parts of water, we have mixed a 10% solution of formaldehyde in water. And so on. You will find the proper strength solutions for your needs. We rarely use a solution greater than 10%.

Formalin has the following disadvantages:

1. It has a pungent odor.
2. It may dry your skin if contact is made.
3. It can irritate the eyes.

Quaternary Ammonium Compounds

Do not be frightened by the long name of these highly effective disinfectants. The fact that most state boards accept the abbreviation "quats" should make you feel better about learning about these powerful chemicals. These compounds are manufactured by several companies under trade names. Quats have the following advantages:

1. They can be effective in very short periods of time.
2. They are odorless.
3. They are colorless.

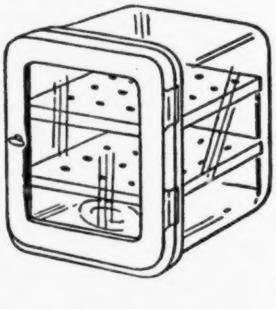
Quats have the following disadvantages:

1. They vary according to the manufacturer.
2. Their labels require careful reading, since each mixture is prepared somewhat differently, and mistakes can be made.

Alcohol

Special solutions of alcohol are recommended for disinfecting metal instruments. In order to be effective, the solution should be 70% or more, as labeled on the bottle. Once again just accept this figure, and it will be explained to you later. Such items as your scissors and electrodes will not rust if cleansed with alcohol. However, do not soak instruments with fine edges, as the edges might dull. Instead use cotton moistened with alcohol.

Up to now, we have discussed how to disinfect materials. What do we do, however, when our materials are already disinfected, but must be set aside to await use on a patron? The answer is – we use a *fumigant. A fumigant is a chemical which produces a vapor (gas) inside a closed container.* We call this container a *dry sanitizer.* In this way we keep previously sterilized materials germ-free.



Dry Sanitizer

Antiseptics:

Disinfectants are too powerful to use on our bodies. In order to fight germs on ourselves, we use chemicals known as antiseptics.*Antiseptics are chemicals which have the ability to prevent the growth of bacteria but not always to kill mature germs.* Some antiseptics used in the beauty salon are:

1. Boric acid – to cleanse the eyes
2. Tincture of iodine – to cleanse cuts and wounds

Antiseptics are safe to use on human skin. However, we should always read the label of the bottle we are using.

Summary

1. Sterilization is the process of destroying germs.
2. The two basic methods of killing germs are by chemical means and by physical means.
4. Physical means of sterilizing are not practical in the salon. Chemical means are practical.
5. Formalin is a mixture of formaldehyde gas in water.
6. Quats are quick, odorless chemical disinfectants.
7. Alcohol is effective as an antiseptic.
8. Fumigants keep sterilized objects germ-free.

Study Aids

Home–

Projects can be made by students. Cardboard mock-ups or wood models of wet and dry sanitizers are very useful as learning tools. Charts showing the shapes of bacteria are valuable. One student prepared a three-dimensional chart of bacteria using pipe cleaners.

Can you answer this?

1. What are the two basic methods of sterilization?
2. List the physical methods of sterilization.
3. List the chemical means of sterilization.
4. What is formalin made from?
5. Using formalin, the 40% solution of formaldehyde gas in water, how can we make a 10% solution of formaldehyde in the shop? How much water should be used? How much formalin?
6. What is a fumigant? Why is it used?

GLOSSARY
What Does It Mean?

Alcohol – a chemical used as an antiseptic. This kind of alcohol is poisonous to drink.

Antiseptic – chemical which has the ability to slow down the growth of germs

Bacteria – one celled, microscopic plant-type organism (singular– bacterium)

Bacilli – **rod-shaped** bacteria (singular–bacillus)

Bacteriology – the study of bacteria

Beautician – a skilled worker in the beauty profession

Chlorophyll – the green coloring matter in most plants that enables them to make food from carbon dioxide and water in the presence of sunlight

Cilia – tiny hair-like projections which help bacteria to move (Singular–cilium)

Cocci – round-shaped bacteria (singular-coccus)

Contagious disease – an infectious disease that can be transmitted from one person to another

Cosmetologist – a skilled worker in the beauty profession

Disinfectant – powerful chemical which destroys germs

Filterable virus – a virus so small it will pass through a porcelain filter

Formaldehyde gas – a gas used in the making of disinfectant solutions

Formalin – a solution of disinfectant made from the mixing of formaldehyde gas with water

Flagellum – a long, whip-like portion of some one-celled organisms. Flagella (plural form) help bacteria to move about.

Fungus – a nongreen, simple plant organism, either parasitic or saprophytic. The term "fungi" (plural form) is used loosely to include yeasts and bacteria as well as true fungi such as molds, plant rusts, mushrooms, and many parasitic micro-organisms.

Germ – the common term for pathogenic organisms

Human disease carrier – a person who carries a contagious disease but is not himself affected by it.

Immunity – the ability of the body to resist and destroy disease–causing germs

Infectious disease – one caused by germs or other parasites. It may not be contagious.

Lysol – trade name for a powerful disinfectant

Microscopic – so tiny it cannot be seen without the aid of a microscope

Mold – a plant-type parasite or saprophyte

Organism – any living thing

Nutrition – the process of nourishment

Pathogenic – capable of causing disease

Protein – a complex material necessary for the living tissues of all plants and animals

Pungent – having a stinging or biting sensation

Sanitary – having to do with cleanliness and health

Spirilla – corkscrew-shaped bacteria (singular-spirillum)

Sepsis – a toxic condition resulting from the spread of pathogenic germs in the body

Staphylococci – cocci bacteria which are grouped in clusters (singular–staphylococcus)

Toxic – poisonous

Vaccination – inoculation with a mild form of a disease in order to prevent a more serious attack of the same disease

Spore – a reproductive body of some of the lower plants, corresponding to the seeds of higher plants

Spore-forming – having the ability to form a hard outer protective covering. Many bacteria, when threatened by their environment, form into spores and are able to survive heat, water, freezing, etc. for long periods. Then when conditions are better, they start to grow again and reproduce.

FIRST AID IN THE BEAUTY SALON

Accidents can happen anywhere, and dispite all our efforts at prevention, accidents will ocur in the salon. It is important to be prepared for them. Accidents may take the following forms:

Burns

1. **Chemical burns**–These burns may be caused by careless use of cold-wave solution or other strong chemicals. In most cases, dilution by flushing the area with water is the best treatment. Afterwards, apply a dry sterile dressing.
2. **Electrical burns**–These burns may be caused by faulty electrical machines or bad wiring. Here again, flush affected area with water and apply a clean sterile dressing. If a severe shock, call a doctor.
3. **Heat burns**–This kind of burn may be caused by hot curling irons, hot liquids, or flames. For treatment, cloths saturated with baking soda are effective on areas with mild burns.

Do not use ointments or sprays of any kind on severe burns. Call a physician at once.

Cuts

There are several ways in which we can cause our patrons or ourselves to be cut in the beauty salon. Most cuts are caused by:

1. Improper use of nippers during the manicure. In this case apply an antiseptic.
2. Improper use of the scissors during the haircut. An antiseptic should be applied.

Epilepsy is a nervous disorder which is characterized by convulsions, foaming at the mouth, and rolling of the eyes.

Treatment: Lay patient on her side. Loosen her collar if necessary. Using gauze or a handkerchief, grasp her tongue and keep it forward. If the mouth is closed, open it by pressing against the jaw joints and keep it open with a clean piece of wood (such as a tongue depressor). Wipe away any foam. Afterwards have person lie down and rest.

Fainting

Fainting is caused by a slowing of the blood supply to the brain. If a person has some prior warning of feeling faint, advise her to bend her head down between her knees or lay her down with her head lower than her feet. If a person has already fainted, lower her head slightly or elevate the lower half of her body. In this manner you will prevent the patron's condition from becoming worse. You will also protect yourself when you see to it that an ill or distressed person is well cared for, since this minimizes the possibility of lawsuits. Of course you should never perform any action which should be performed by a medical doctor.

Falls

We must bear in mind that some individuals are not as honest as we would have them be. There have been situations where an individual entered a beauty salon with the idea of suing the owner, before anything at all had happened. Such a person might deliberately fall in the salon, for example. If you think this has been the case, it is best not to touch this person, as this would only complicate your involvement. By making sure your salon is a safe place to be in, you not only protect your patrons from accident, but you do not give the scheming patron a chance to sue dishonestly. For example,

1. Always mop the floor dry when something is spilled.
2. Keep the floor free from foreign objects.
3. Keep wires out of reach of the patrons–especially children.
4. Keep sharp instruments out of reach.

There are many more ways you can keep your salon safe to be in. Make a list of these rules for safety and post it on your shop wall.

NOTE – As we said, accidents will happen. Be sure to have the proper amounts and types of insurance to cover any claims which may be made against you.

Mouth–to–Mouth Breathing

In cases of electrical shock or smoke poisoning, it is important that air be forced in and out of the victim's lungs. It is a good idea for every person to learn the technique of restoring breathing by mouth-to-mouth resuscitation.

Call a physician in all serious cases to protect yourself and your patron.

Nosebleed

If a patron develops a nosebleed, it is best to loosen any collar or neck strip. Apply cool water (in pads or towels) to her face and the back of her neck.

Summary

1. There are three types of burns: chemical, electrical, and heat.
2. Cuts should be treated with antiseptics.
3. Call a physician in all serious cases of injury or illness to protect yourself and your patron.

Study Aids

Class–

This is another good time for role-playing in the classroom. Select two volunteers. One person plays the patron. The other student plays the part of the operator. The patron should "faint." How should the operator react? Suppose the patron was having an epileptic fit? What should the operator do? The students should then reverse their roles. The rest of the class should offer their suggestions after the acting out of the scene.

Can you answer this?

1. Explain how chemical burns are caused and treated in the salon.
2. Explain how cuts should be treated.
3. How should a person who feels faint be treated?
4. How should a person who has already fainted be treated?
5. How can you recognize an epileptic fit?
6. What should be done for nosebleed in the salon?

UNIT III – THE HUMAN BODY

Introduction

The human body has been compared to a machine. As with all machines, if we take reasonable care of ourselves and use good judgment in dealing with our bodies, we can keep ourselves "running" smoothly for many years. If we are careless, our bodies might develop problems or break down completely.

On the other hand our bodies are more fantastic than the most complicated machines. For example, the human body can––

1. grow from a tiny cell to a full grown adult.
2. maintain itself by repairing certain parts before they wear out completely and replace damaged or worn-out parts.
3. regulate its own workings automatically and with perfect precision.

These are only a few of the many abilities the human body has.

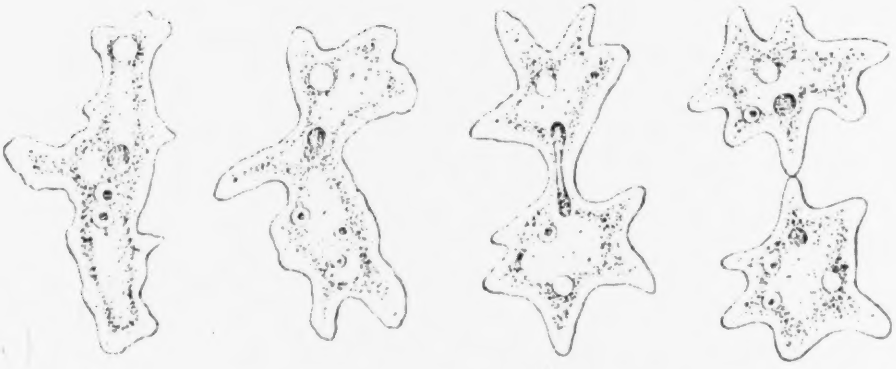
As cosmetologists you will have close contact with the body. You should know its parts so that you can perform massage intelligently. You should know bone and muscle structure so that you will know how to improve on these structures by the use of cosmetics and hairstyling. Finally, as an educated high school student, you should know as much about how the human body functions as you can.

Cells

We have already discussed microscopic animals called protozoa, and microscopic plants called fungi. Can we now accept the idea that man is very much like the tiniest animal or plant? For example, all living things–trees, insects, bacteria, or people–are made of a substance called *protoplasm*. Protoplasm differs in its makeup in different creatures, and in the same creature it differs from tissue to tissue in the body. Some protoplasm is as thin as water, and some as thick as molasses. So the word "protoplasm" is really a general term for "living matter."

Protoplasm is always found in tiny "building blocks" called *cells*. Therefore, we say that *all living things are made up of cells*. A human body is made up of many, many billions of cells.

Whether a one-celled animal or a human being, all living things contain protoplasm. Science has been successful in producing marvellous plastics, drugs, rubber, and textiles, among many other objects, but science has not yet been able to create protoplasm. As a result we have not yet been able to create a living thing.



Reproduction of an ameba by cell division

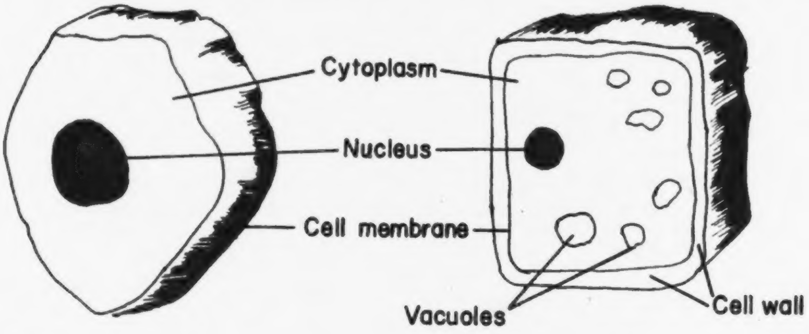
There are many important differences between humans and microscopic animals, however. For example, when an ameba (a one-celled animal) splits into two, each part goes its own way, resulting in two separate amebas. When a human cell splits into two, the cells remain connected. The more this happens, the larger the human grows. The splitting of the human cell is called *cell division.*

Let us look at a human cell more closely. It may be a muscle cell, or a skin cell, or a bone or nerve cell, but each tiny cell can perform all of the major life functions that our entire bodies perform as a whole. Cells can:

1. Absorb food and use it to build protoplasm. This process is called *assimilation.*
2. Get rid of waste materials. This process is called *excretion.*
3. Grow in size. This process is called *growth.*
4. Respond to changes in their environment. This process is called *irritability.*
5. Move. This process is called *contractibility.*

Structure of Cells

While human cells vary greatly in shape, they always have the following major parts:



ANIMAL CELL

PLANT CELL

TYPICAL CELLS AND THEIR PARTS

1. *Cell Membrane*–an outer covering through which materials pass into and out of the cell.
2. *Cell Nucleus*–the part of the cell responsible for the growth of the cell, for carrying out most of the purposes of the cell and for cell division (reproduction).
3. *Cytoplasm*– the thin protoplasm of the cell, outside the nucleus. The food and water for the cell are stored in the cytoplasm.

We now have something of a working definition of a cell.*Cells are the basic building blocks of all living matter.*

Summary

1. All living things are made of protoplasm, but protoplasm is really many different kinds of substances.
2. Every living thing has at least one cell. Some plants and animals have many billions of cells.
3. The cells of the body increase in number by cell division – one cell splits into two.
4. Human cells perform these jobs: assimilation, excretion, growth, irritability, contractibility.
5. The protoplasm of all human cells consists of: the cell membrane, the nucleus, and cytoplasm.

Study Aids

Would you like to see a cell? Volunteers can perform the following experiment:

EXPERIMENT

Objective: To see the parts of the human cell

Materials:
toothpick
drop of water
microscope
microscope slide

Procedure: Scrape off a bit of "lining" of your cheek with the toothpick. Make a wet mount of the scrapings and stain it with dilute iodine. Look at the slide under the microscope.

Observation: Do you see the parts of the cell? Each student should make a diagram of what he sees.

As we move on with our discussion of the amazing human body, you might be interested in actually seeing life itself begin and grow in the form of a baby chick. The development of the chicken from one tiny cell to the birth of the baby chick is a good deal like the development of the human baby within the womb of the mother. Here is an experiment which is easy and fun to do.

EXPERIMENT

Objective: To observe the growth and development of the chick embryo

Materials:
An incubator (may be made out of wood) large enough for several baby chicks
A thermostat (wafer-type suggested)
A thermometer
A cup of water (changed daily)
One or more fertilized chicken eggs
One dissecting kit

Procedure: Place eggs on a tray or grating inside the incubator. Set the temperature of the incubator at 99 to 100 degrees Fahrenheit. Any lower or higher temperature will cause problems. Place cup of water in incubator for proper humidity. Eggs will hatch in 21 days. Turn eggs daily so that different sides of the eggs are exposed to the light bulb or heat supply inside the incubator.

Purchase enough eggs so that an egg may be broken open every other day. In this way, the chick can be seen at various stages of its development within the egg. Students may volunteer to break open the eggs. Use instruments to separate the chicks from the eggs.

Conclusion: For the first several days it is difficult to recognize the growing embryo as a chicken. It could be mistaken for a human embryo. Finally the parts of the chicken will become clear, and we will see a full-grown chicken emerge at about the 21st day.

Can you answer this?

1. Why is the human body often compared to a machine?
2. Why has science not yet been able to create a living creature?
3. What are some things that the human body can do that a machine cannot do?
4. What is the name given to all living matter?
5. List the three major parts of the cell.
6. What is meant by "assimilation" in the cell? By "excretion"?

TEAMWORK AMONG CELLS

Tissues

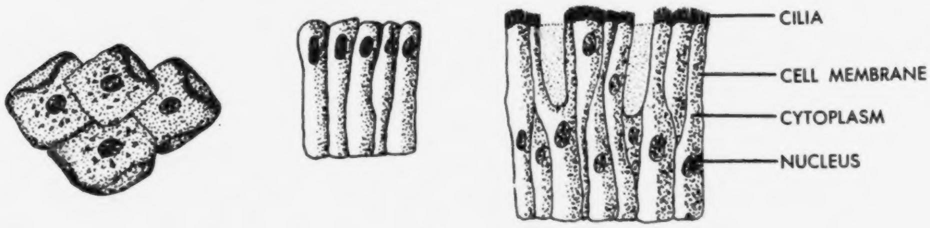
Remember our discussion of one-celled animals? We said they live in much the same way we do. Of course this is not completely correct. There are important differences. The life of a human is much more complicated than that of a one-celled animal, as any busy teenager knows. Because our bodies perform so many different jobs, we need special types of help from our cells. All kinds of cells mixed together could not possibly do the jobs we ask of them. Because of this need, the cells group together as the unborn baby grows. When cells are grouped together we say they make a *tissue*. Since we have different types of cells in the body, each type of cell is grouped with its own kind. We now have a definition of a tissue. *A tissue is a group of cells all of the same type, which join for a specific job.* Remember, a tissue can be made of only one type of cell.

Types of Tissues

If every grape in a bunch of grapes is red, we say we have a bunch of red grapes. If every grape in a bunch of grapes is purple, we say we have a bunch of purple grapes. If every grape in a bunch is green, we know we have a bunch of green grapes. All three bunches have one thing in common. Do you know what that is? Correct–all the bunches are grapes. It is the same way with tissues. Tissues are made of cells, but different types of cells make up different types of tissues. Each bunch (or group) of cells has a different name and function, but all are cells. The different types of tissue are:

1. Covering tissue–Skin or Epithelial tissue

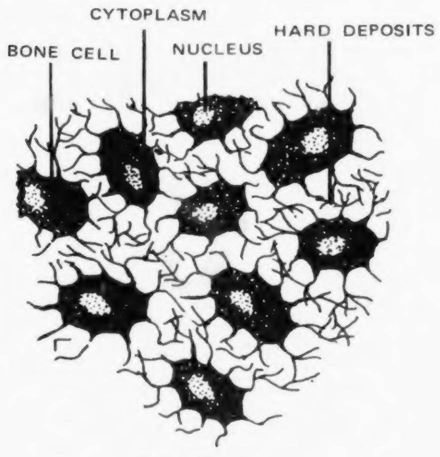
This has a job of protecting the cells below the surface. If you have ever fallen and scraped the top layer of skin, you were able to see the raw layers underneath. Skin protects these raw layers. Epithelial tissue also protects the inside surfaces of the body, like the canals in the nose and ears, the windpipe, the stomach, the intestines, etc.



Types of Epithelial Tissue

2. Support tissue–Bone

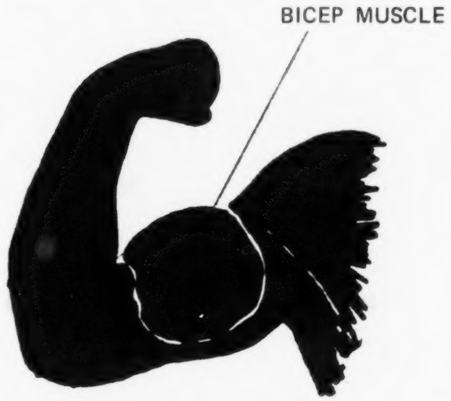
Most larger animals have a frame to support their bodies. This frame is a skeleton of hard bone tissue. Bone cells, like all other cells, are made of protoplasm. Between the cells the bone cells have built deposits of nonliving minerals, which are what make bones hard.

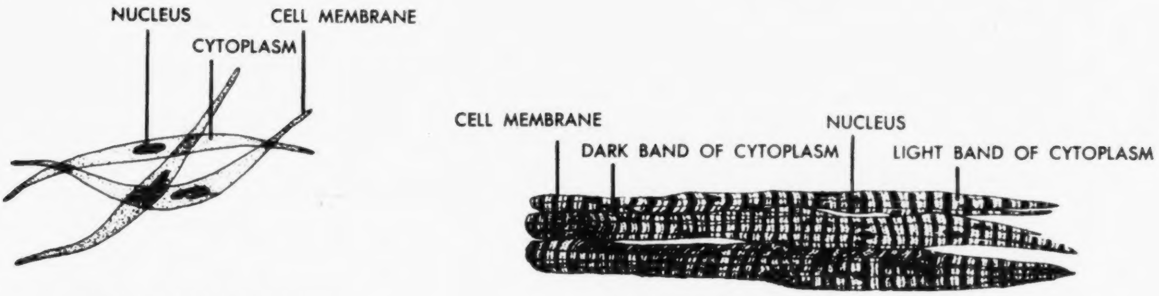


Bone Tissue

3. Tissues to move and work–Muscle tissue

Muscle cells are long and thin, with bands or stripes across them. These bands can grow thicker or thinner to lengthen or shorten the muscle. There are also smooth (unstriped) muscle cells in the walls of the food tube and the blood vessels.





SMOOTH MUSCLE CELLS

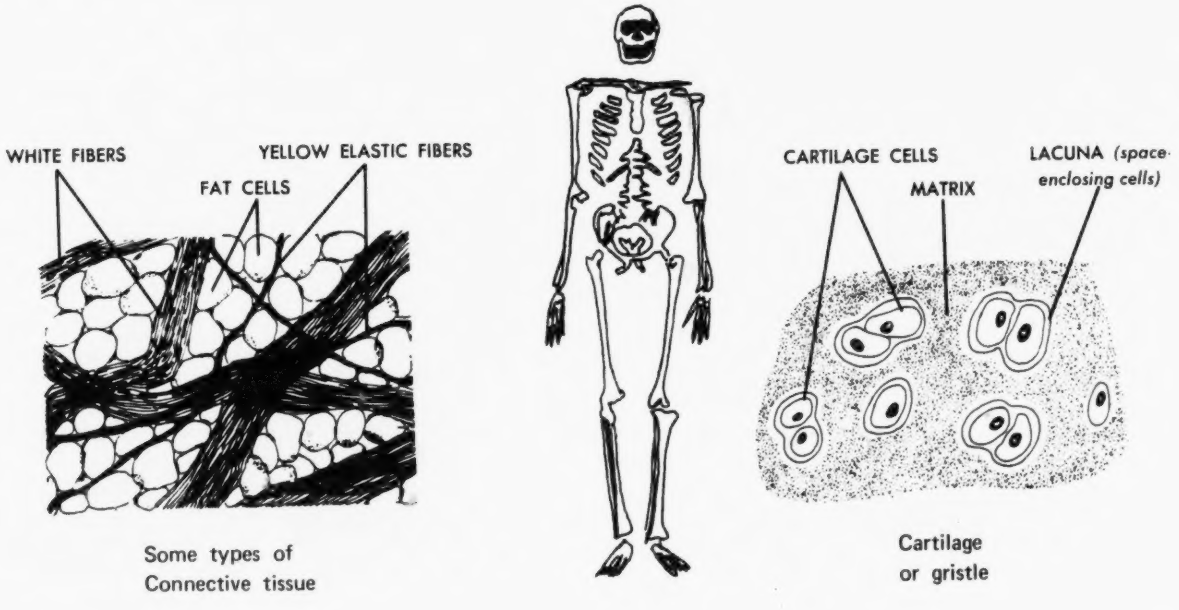
STRIPED MUSCLE CELLS

Muscle Tissue

4. Tissues to connect–Ligaments and Tendons

Ligaments are strong connecting tissues which keep bones "hanging together". Tendons are fibrous cells which connect bones to muscles. A sudden severe strain on your body could cause you to strain a ligament or a tendon. Doctors suggest rest, hot baths, and masage to help the ligaments and tendons to heal.

NOTE – A good knowledge of massage in this case can mean extra business for the beauty salon.



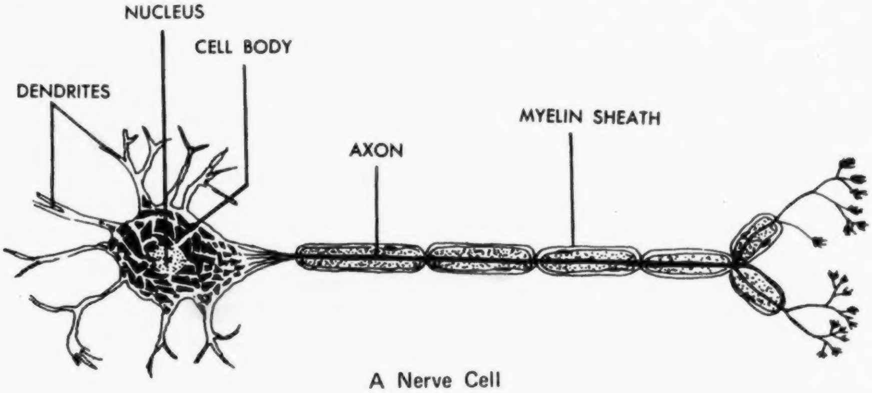
Some types of Connective tissue

Cartilage or gristle

Bones are held together by connective tissues.

5. **Nerve tissue**

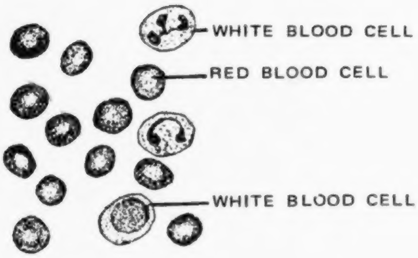
The brain, spinal cord, and nerves are all packed full of nerve cells called neurons. These cells keep our brain in close communication with the rest of our body. Some of these microscopic cells are several feet long. There are over 12 billion neurons in the brain, and billions more neurons form the nerve branches throughout our body. They carry "messages" (sorts of electrical impulses) from the sense organs (eyes, ears, skin, etc.) to the spinal cord or the brain, and then carry impulses from the brain or spinal cord to muscles, glands, or whatever part needs to respond to the "message." (We *see* a car coming, and we *step back* from the curb.)



A Nerve Cell

6. **Liquid tissue–Blood**

This precious liquid carries the body's food, waste, hormones, and other life-giving objects. Blood is usually considered as a tissue in liquid form.



ORGANS

We have already discussed cells which are joined in groups. Suppose we combine some of the different groups of tissues, for example muscle and epithelial and liquid tissue, with some nerve and connecting tissue added. What have we made? Perhaps a heart. A heart is an organ. We can now say that *an organ is a group of different kinds of tissues that work together to accomplish a particular purpose.* An eye is an organ, so is an ear, an arm, a leg, the brain, the stomach, the liver, etc.

SYSTEMS

By now we realize that we are in the process of "building a human being on paper." First we took cells, then we grouped these cells together and made tissues. Then we took different tissues and combined them and made organs. Can you guess what the next step is? *A group of different organs that work together for a special job is called a* *system.* There are nine systems of the body. We will study these systems separately to gain a better understanding of how the human body works. The nine systems are:

Skeletal system
Muscular system
Nervous system
Circulatory system
Digestive system
Excretory system
Endocrine system
Respiratory system
Reproductive system

Summary

1. In order to perform the many different jobs our bodies do, cells must be grouped together.
2. Tissues are groups of cells, all of the same type, joined to do a specific type of job.
3. The types of tissues are skin, blood, bone, muscle, nerve, and connecting tissues.
4. Organs are combinations of different kinds of tissues joined for a specific purpose.
5. Systems are made of different organs working together for a specific job.
6. There are nine systems of the body.

Study Aids

Home–

Reports may be prepared on the various types of tissues in the body, and these reports may be read to the class.

Can you answer this?

1. What is the function of connecting tissue?
2. What is the hardest tissue in the body?
3. List the systems of the body.
4. Define an organ. Give 5 examples.
5. Define a system.
6. Define a tissue. Give 5 examples.
7. Why is blood generally called a tissue?

GLOSSARY

What Does It Mean?

Assimilation–process of absorbing and using food to build protoplasm

Anatomy–(uh-nat'-o-mē) – the study of the structure of the body

Ameba–a microscopic, one-celled animal

Cell–the basic unit of all living things. Cells are the building blocks of life.

Cell division–the reproduction of a cell: the dividing of a cell into two individual cells

Epithelial tissue–technical term for skin and other covering tissue

Excretion–the process of getting rid of wastes

Histology–the branch of anatomy that deals with the very small parts of the body as seen under the microscope

Ligament–a type of connecting tissue which holds bones together

Irritability–the ability of a cell to respond to changes in its environment

Nucleus–the thicker part of the cell; the part of cell most responsible for growth, performance, and reproduction of the cell

Physiology–the scientific study of the functions of each particular part of the body

Tissue–a group of cells which are alike and perform a special type of job

Tendons–fibers which connect muscles to bones

THE SKELETAL SYSTEM

The skeletal system consists of the hardest tissue found in the body–bone tissue. Just as a hanger supports a suit of clothes, so your skeleton supports your body. There are 206 bones in your body. In addition to serving as the framework of your body, bones also protect vital organs. Can you think of any organs protected by bone? The heart and the brain are two of the most important organs protected by bone. The heart is protected by the thorax (rib cage), and the brain is protected by the cranium (top of the skull). Would you say that the eye is protected by bone?

Bone is made up of both living and non-living matter: two-thirds of bone is non-living, and the rest is living matter. This combination of living cells and mineral matter helps us to have strong, well-formed bodies. Bones exist in four different shapes:

1. Long bones– as in the legs and arms
2. Flat bones– as in the skull and pelvis
3. Short bones– as in the fingers and toes
4. Irregular bones– as in the vertebrae of the spine

Structure of Bone

1. *The periosteum*

   The periosteum is the outer covering of bone. It is a membrane made of connective tissue. This covering has the ability to allow blood vessels to pass through it, into the bone itself.

2. *Compact bone tissue*

   "Compact" is the term we give to the hard bone tissue.

3. *Cancellous bone tissue*

   This spongy tissue is at the inside of the bone. In the longer–type bones, cancellous (kan'-sell-us) tissue appears at the ends and acts to soften the contact between bones.

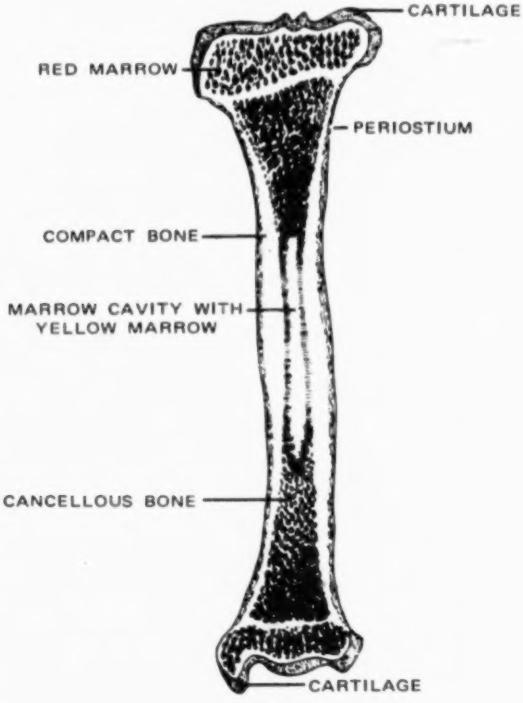
4. *Marrow*

   The center of bone and the cancellous parts contain marrow. Marrow tends to be yellow in color in the center hollows of the bones and red at the ends of the long bones. Red blood cells are manufactured in marrow and then are sent into the blood stream.

5. *Cartilage (car´-til-ij)*

Cartilage is a material much like bone, except it lacks some minerals. It therefore is not as hard as bone. A newborn baby's bones are largely cartilage, which gradually hardens into bone. Some cartilage remains, however, on the ends of bones, for example. Your nose "bone" is cartilage.

When a bone is broken, its healing takes place when the bone-making cells divide and produce new bone from the minerals in the food eaten; this fuses the bone together.



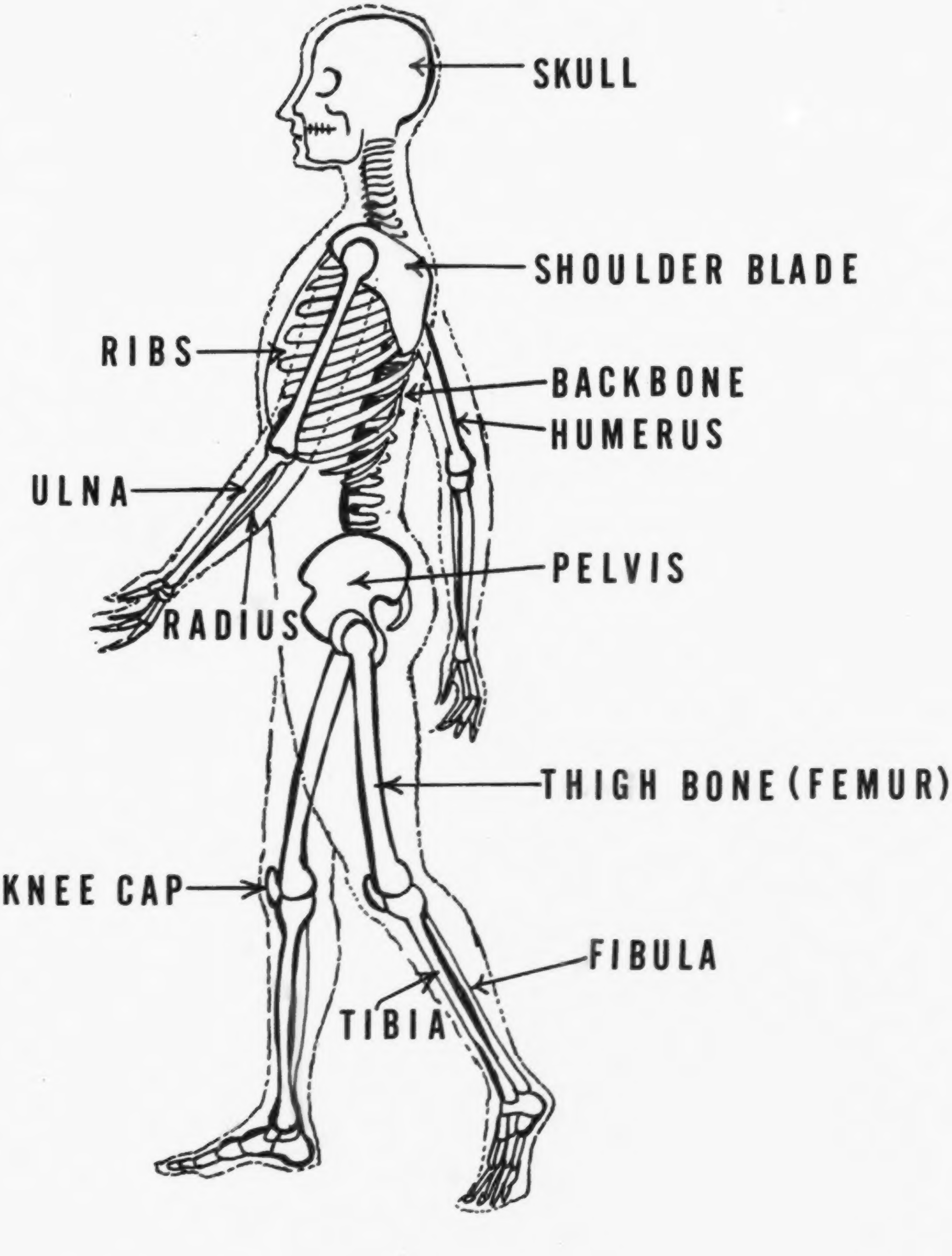
INTERNAL

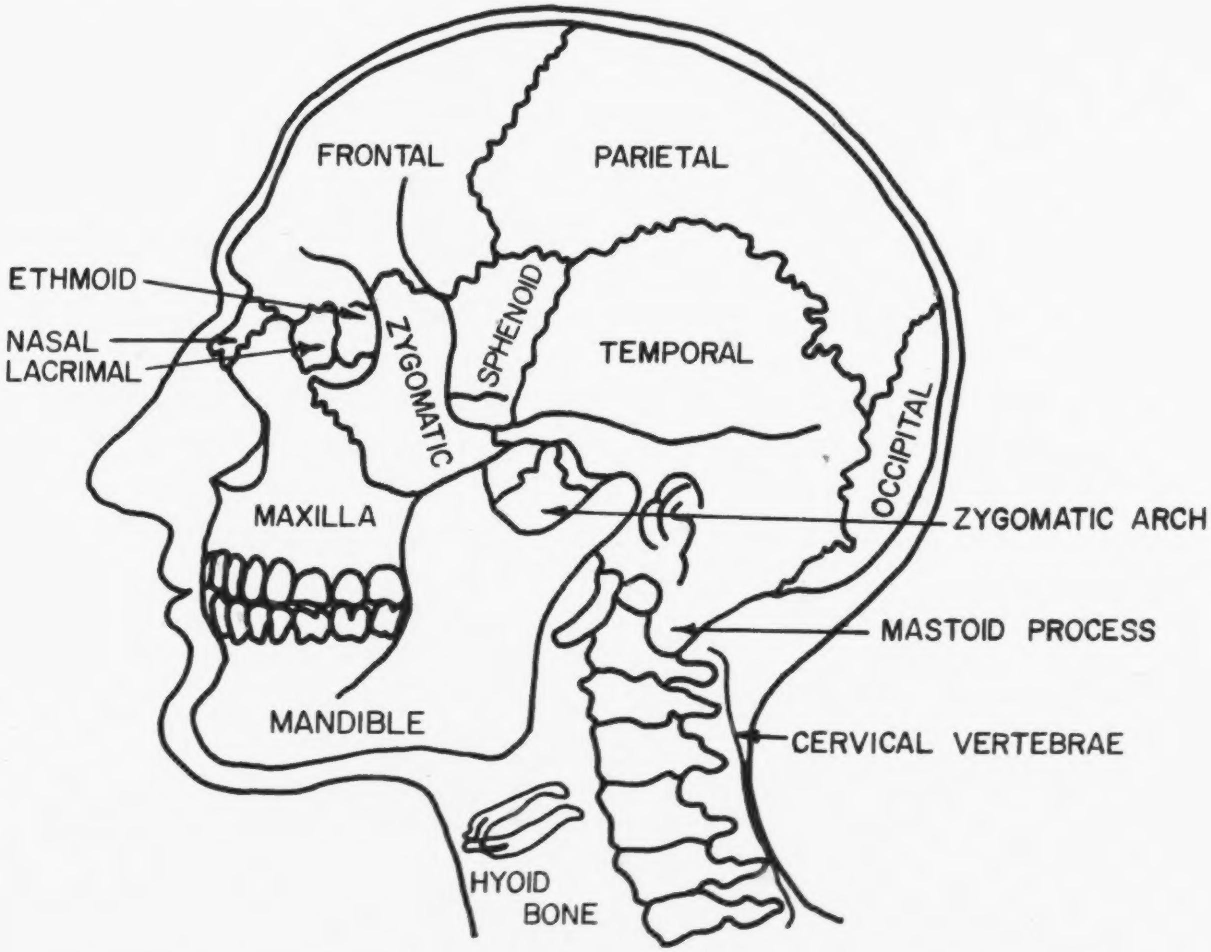
EXTERNAL

Joints

The places where two bones come together and fit against one another are called joints. There are two types of joints:

1. Fixed joints. These are mainly the joints in the skull. They cannot move.
2. Movable joints. These can move, although a few, like those in the spine, can move very little.
    a. Ball and socket– shoulder and hip
    b. Pivot– neck and forearm
    c. Gliding– wrist and ankle
    d. Hinge– elbow and knee


SKULL
SHOULDER BLADE
RIBS
BACKBONE
HUMERUS
ULNA
PELVIS
RADIUS
THIGH BONE (FEMUR)
KNEE CAP
FIBULA
TIBIA



BONES OF THE HEAD, FACE AND NECK

Bones of the Skull. The skull is divided into two sections:

A. Cranium, or top portion of the skull. The cranium has the following bones:

1. *Occipital* (ok-sip'-i-tal) bone at the back and base of the cranium.
2. Two *Parietal* (pah-ry'-i-tal) bones which join to form the sides and crown of the cranium.

3. *Frontal* bone, which forms the forehead and roof of the eye sockets.

4. Two *Temporal* bones which form the sides or "temples" of the cranium.

5. *Ethmoid* bone, which forms the spongy material between the eye sockets at the root of the nose.

6. *Sphenoid* (sfe'-noid) bone at the base of the cranium in back of the eye sockets.

There are eight separate cranial bones in all. Right?

B. Facial bones–bones in the lower portion of skull. The bones in this area are:

1. Two *nasal* bones which lie side side by side to form the bridge of the nose. These bones are oblong shaped.

2. Two *turbinals.* These curled - up bones form the outer walls of the two nasal depressions.

3. *Vomer* bone. This bone is in back of the nasal depression and acts as the dividing wall (septum) of the nose.

4. Two *zygomatic* bones (zy-go-mat'-ik). These bones form the cheek area and the floor of the eye sockets.

5. Two *lacrimal* bones (lak'-ri-mal). These bones form the inner walls of the eye sockets. Their tissue contains canals which hold tear ducts.

6. Two *palatine* bones (pal'-ah-tīn). These bones form the floor of the nasal depressions and the roof of the mouth.

7. Two *maxilla* bones (mak-sil'-uh). These two bones join to form the upper jaw.

8. *Mandible* (man'-di-bl). The base of the lower jaw. The largest bone of the face.

Bones of the Neck

1. *Hyoid.* (hy'-oid) The U-shaped bone situated between the root of the tongue and the front part of the larynx

2. *Cervical vertebrae* form the top part of the vertebral (spinal) column (singular, vertebra).

Bones of the Chest

Thorax. The bony cage consisting of the breastbone, spinal column, ribs, and connective tissue.

Bones of the Shoulder, Arm, and Hand

1. Shoulder

   a. *Clavicle* (klav'-i-kl). The bone at the top of the shoulder, also called the collar bone.

   b. *Scapula* (scap'-u-la). The bone at the back of the shoulder, also called the shoulder blade.

2. Arm

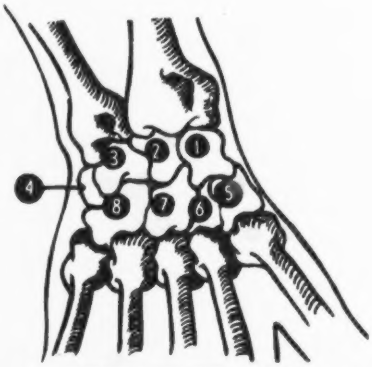
   a. *Humerus* (hyūm'-uh-rus). The bone of the upper arm.

   b. *Ulna* (ul'-nuh). The bone in the forearm on the little finger side.

   c. *Radius.* The bone in the forearm on the thumb side.

3. Wrist

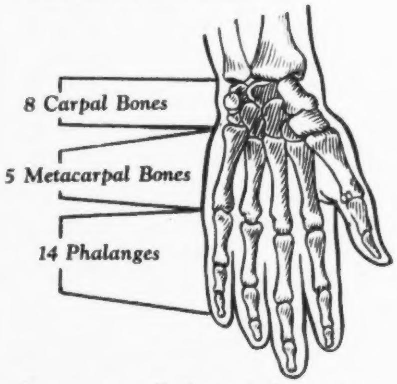
   1. *Navicular*
   2. *Lunate*
   3. *Triangular*
   4. *Pisiform* (smallest bone)
   5. *Greater multangular*
   6. *Lesser multangular*
   7. *Capitate* (largest bone)
   8. *Hamate*



BONES OF THE WRIST

Carpus is the term for the wrist. *Any bone* of the wrist is called a *carpal bone.* There are eight bones in the wrist.

Metacarpus is the term for palm. Any bone of the palm is called a *metacarpal bone.* There are five bones in the palm.



The fingers are called *digits.* Any bone in the fingers is called a *phalange bone* (fā'-lanj). There are fourteen phalange bones in the hands.

NOTE – Certain bones cannot be reached during a massage. These bones are the ethmoid, turbinal, vomer, lacrimal and palatine bones.

Summary

1. Bone is the hardest tissue in the body.
2. There are 206 bones in the body, in different shapes and sizes.
3. Bones are made up of both living and non-living matter.
4. The important structures of bone are: marrow, periosteum, compact, and cancellous tissues.
5. Bones are connected at joints.
6. Joints are movable or not movable. There are four types of movable joints: ball and socket, pivot, hinge, and gliding.
7. The skull has two sections: the cranium and facial area.
8. There are eight bones in the cranium, fourteen bones in the face, two bones in the shoulder, three bones in the arm, eight bones of the wrist, five bones in the palm, and fourteen bones in the fingers.

Study Aids

Home–

Students could prepare reports on the skeletal system. Possible topics:

1. Functions and structure of the skeletal system
2. Bone and its diseases
3. Common injuries to bone and simple treatments.

Class–

Miniature skeletons are available for purchase. One of these could be used to demonstrate the relationships between the bones and how they move.

Can you answer this?

1. What is the term for the bony cage which protects the heart?
2. List the shapes of bone. Give an example of a part of the body for every one of the shapes of bone.
3. Why is soft, spongy tissue located at the ends of certain bones?
4. What is one main function of marrow?
5. List the types of movable joints. Give an example of each.
6. What are digits? What are phalanges?
7. Define the term "carpus." Define the term "metacarpus."

GLOSSARY
What does it mean?

Bone–hard tissue which serves as the framework for the body

Cartilage–firm, elastic tissue similar to bone but lacking in full mineral content

Carpus–technical term for wrist

Cancellous–soft, spongy bone tissue

Cranium–upper portion of skull

Compact–hard bone tissue

Digits–technical term for fingers

Limbs–the arms and legs

Joint–a point of meeting between two or more bones

Metacarpus–technical term for the palm

Orbits–eye sockets

Os–Latin term for bone

Osteology–scientific study of the skeletal system

Phalange–a bone of the fingers

Synovial fluid–liquid which lubricates bones at the joints

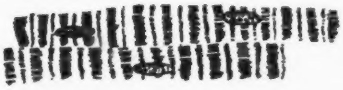
Thorax–bony cage of the chest

MUSCULAR SYSTEM

Earlier we talked of grouping cells together to form tissues. Muscle tissue is another type of tissue made of cells. Muscle cells appear different from most cells due to their long shapes. We say muscle cells are like long fibers. These fibers are gathered into bundles and it is this "bundle" we call a muscle. There are about 500 of these "bundles" or muscles in the body.

Basically there are three types of muscles in the body.

1. Voluntary muscles–(skeletal muscles). These muscles are attached to the bones of the skeleton. They can be purposely directed by our own will. In other words, when our brain gives a command (such as thinking,"lift that pencil"), the appropriate muscles will act. The action is *voluntary*–done intentionally. These muscles are striped in appearance and have more than one nucleus to each cell.



2. Involuntary muscles (muscles of organs). These muscles are in the walls of our blood vessels and many of our internal organs. Most of them cannot be controlled by our command. Through the magic of our bodies, these muscles do their jobs on their own, moving blood, food, waste products, etc. Involuntary muscles are smooth in appearance.

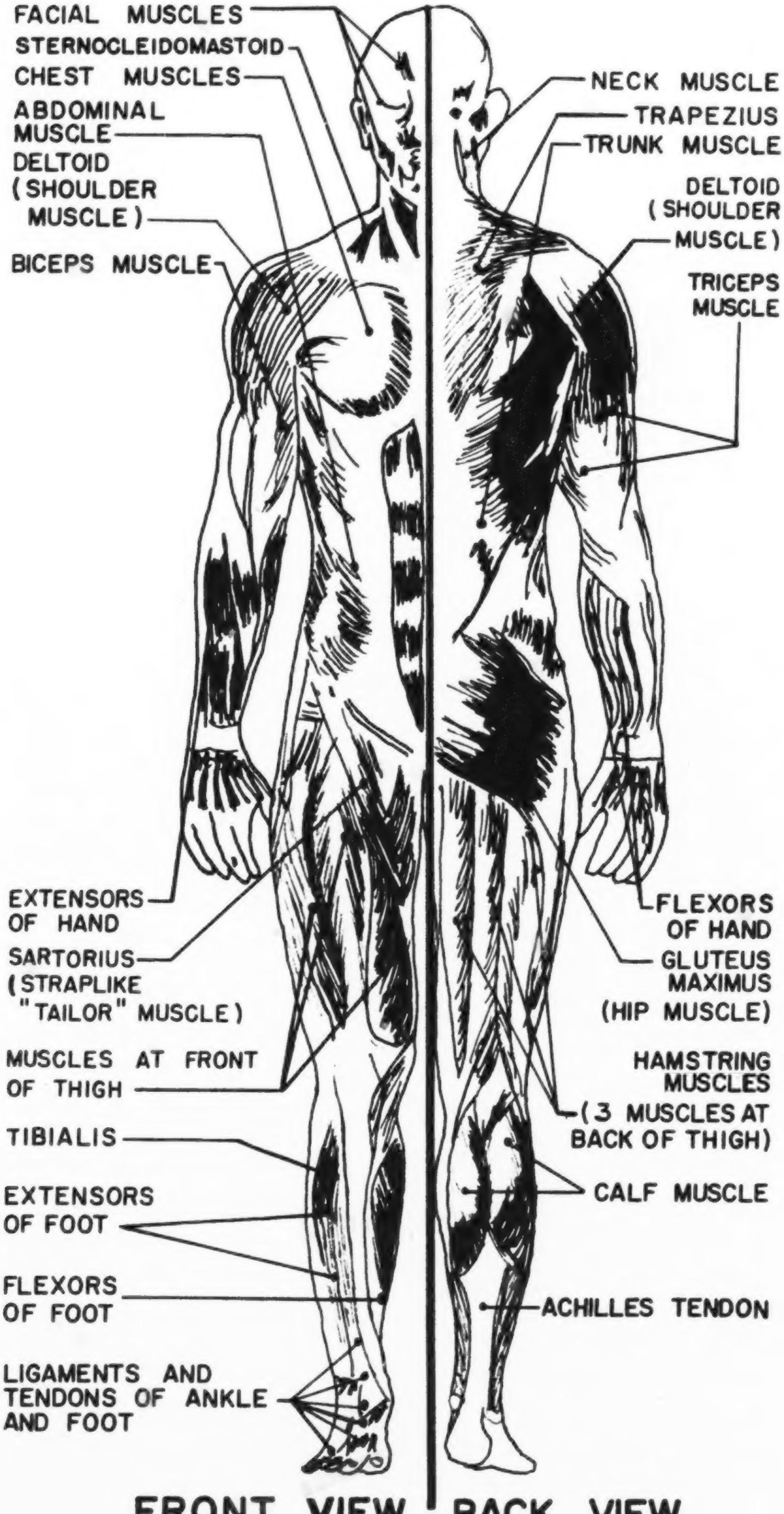
3. Cardiac muscle (heart muscles). These muscles are present only in the heart. They are the most powerful muscles of the body. Cardiac muscle is involuntary, yet it is striped and quite similar to voluntary muscles.

Functions of Muscles:

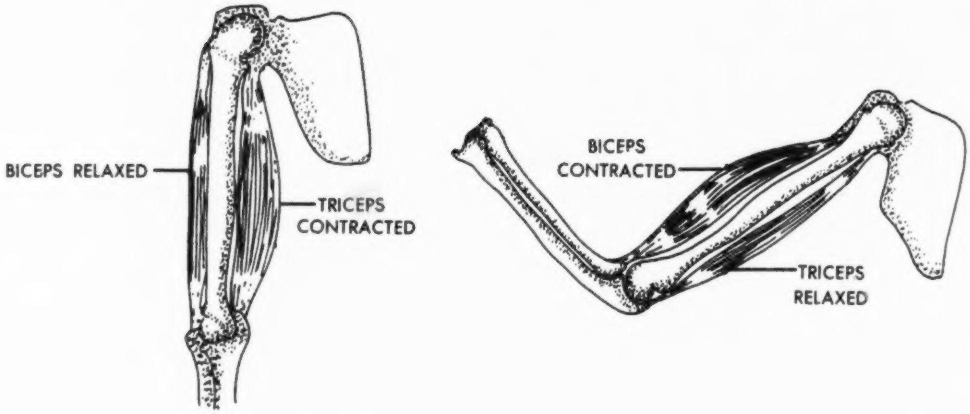
The voluntary muscles not only move us around, but enable us to stand still, either upright, crouched, or however we wish. To do this, the muscles are attached to the bones by tendons, which grow from the ends of the muscle cells. The tendons are attached to the periosteum of the bone.

A muscle performs its work by *contracting;* that is, it becomes shorter and thicker when it is stimulated by a message from the brain. When a muscle is relaxed or not contracted, it is long and extended. Muscles never completely relax. We use the voluntary muscles even when asleep.

THE SKELETAL MUSCLES

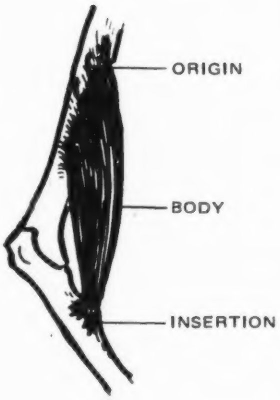

FACIAL MUSCLES
STERNOCLEIDOMASTOID
CHEST MUSCLES
ABDOMINAL MUSCLE
DELTOID (SHOULDER MUSCLE)
BICEPS MUSCLE
NECK MUSCLE
TRAPEZIUS
TRUNK MUSCLE
DELTOID (SHOULDER MUSCLE)
TRICEPS MUSCLE
EXTENSORS OF HAND
SARTORIUS (STRAPLIKE "TAILOR" MUSCLE)
MUSCLES AT FRONT OF THIGH
TIBIALIS
EXTENSORS OF FOOT
FLEXORS OF FOOT
LIGAMENTS AND TENDONS OF ANKLE AND FOOT
FLEXORS OF HAND
GLUTEUS MAXIMUS (HIP MUSCLE)
HAMSTRING MUSCLES (3 MUSCLES AT BACK OF THIGH)
CALF MUSCLE
ACHILLES TENDON

FRONT VIEW BACK VIEW



An individual muscle has three main parts:

1. Origin–the place where the muscle is attached to relatively immovable bone. This is the end that moves less during a contraction or relaxation.
2. Body–the main part of the muscle.
3. Insertion–the place where the muscle is attached to the bone that moves more. This is the end that moves more during a contraction or relaxation.



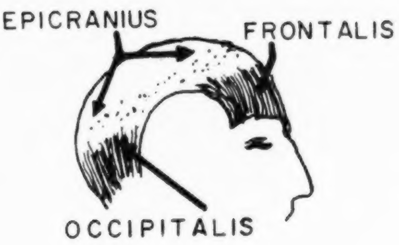
Muscle Massage

The cosmetologist will only massage voluntary muscles of the scalp, face, neck, arms, and hands. As a rule we massage muscles in the direction from the more movable part (insertion) to the less movable part (origin). On the next several pages will be found illustrations of these muscles.

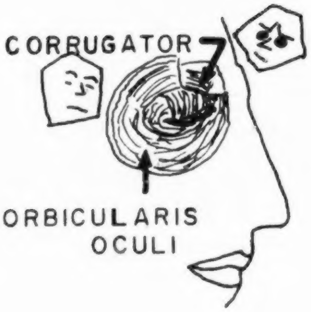
Muscles have the following abilities:

1. They can stretch and contract.
2. They can respond very quickly to stimuli (a command).
3. Due to constant activity, they produce much of the body's heat.
4. They help us remain upright and to move about.

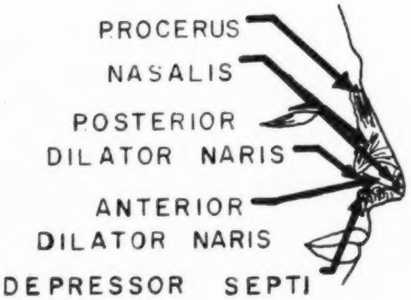
MUSCLES OF
THE SCALP



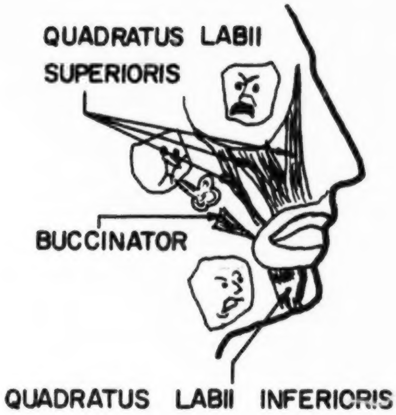
MUSCLES OF
THE EYEBROWS

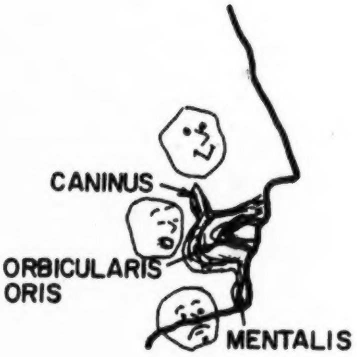


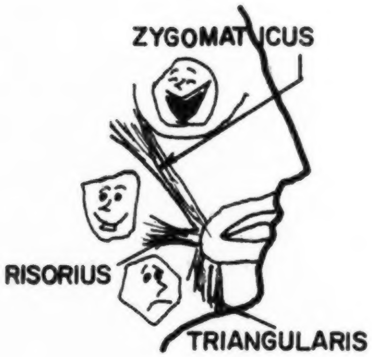
MUSCLES OF
THE NOSE



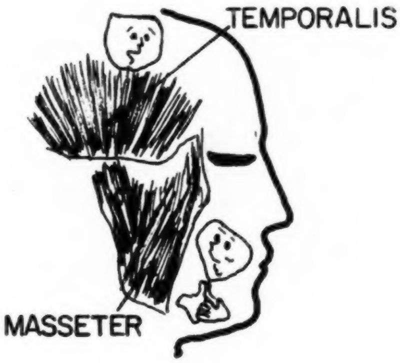
MUSCLES OF THE MOUTH



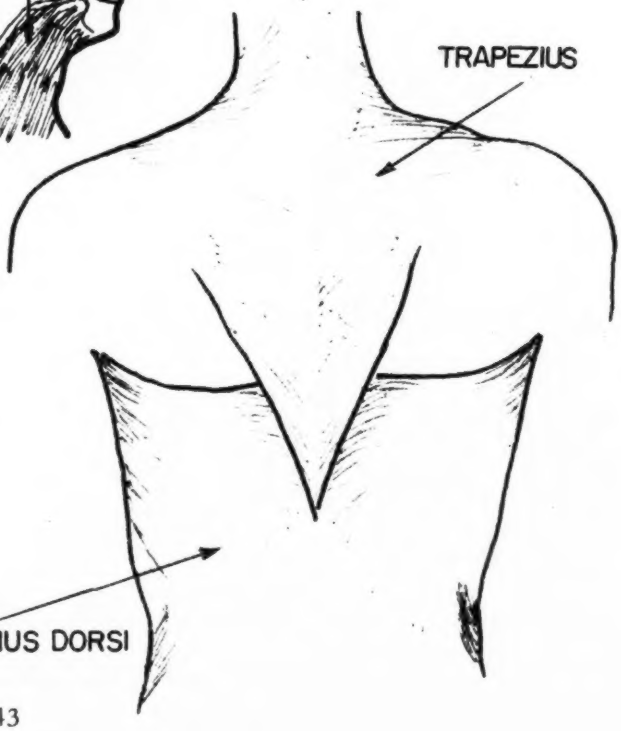


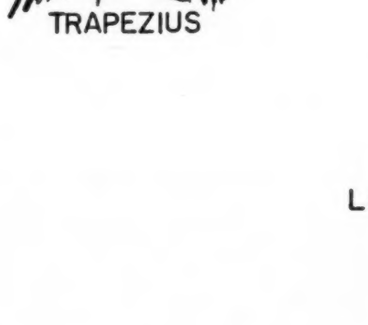


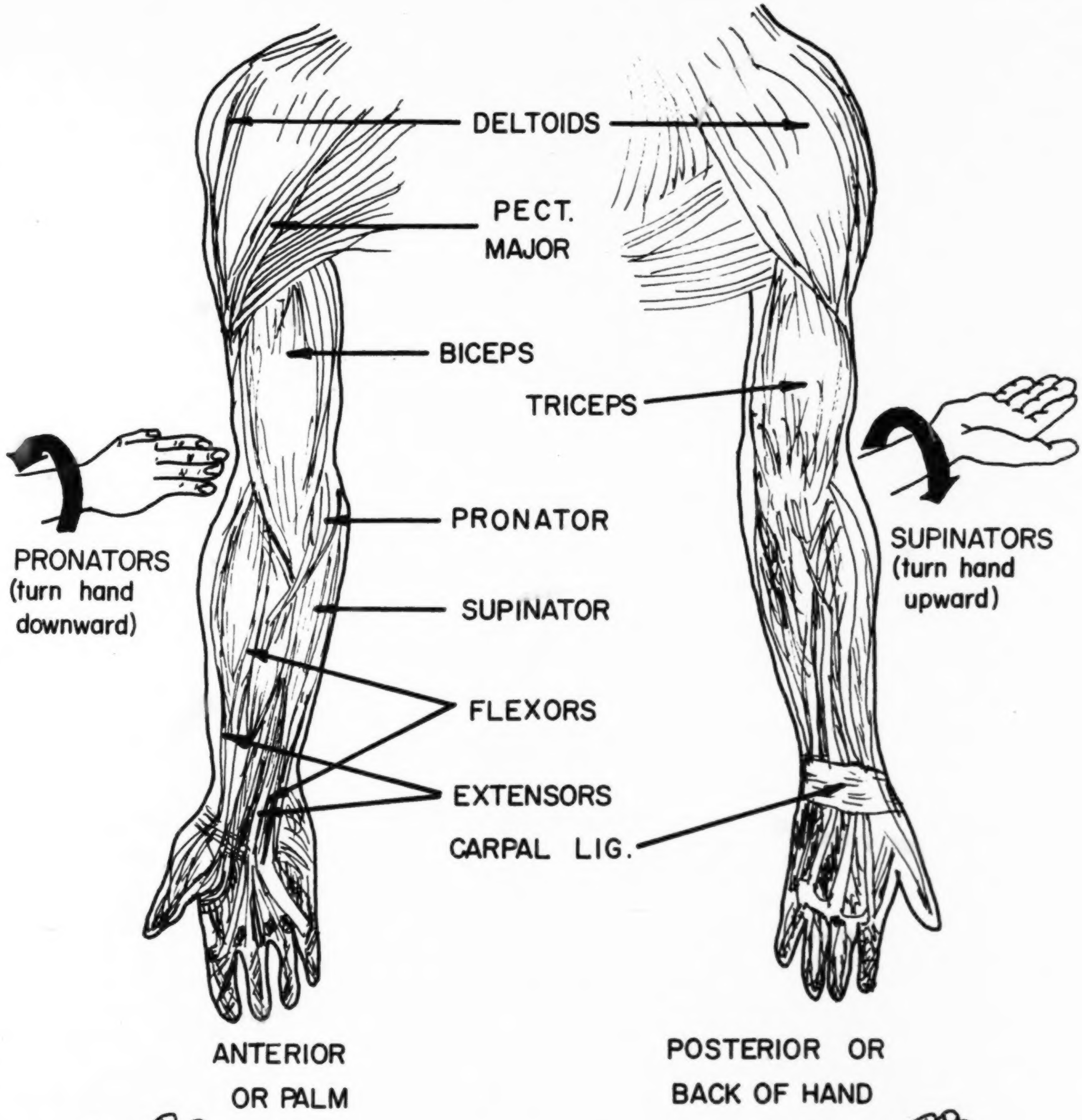
MUSCLES OF MASTICATION



MUSCLES OF THE NECK AND BACK







MUSCLES OF THE SHOULDERS, ARMS AND HANDS

It is true that muscles can be increased in size by regular exercise. In this way individual fibers become shorter and thicker. In women this is not particularly attractive, and efforts should be made to avoid those exercises which enlarge muscles, such as weight lifting, etc.

When muscle tissue uses food to produce energy and heat, it produces waste products, which are carried to various organs for excretion. One such waste product is lactic acid. If muscular activity is too vigorous or too prolonged, so much lactic acid is produced that the blood cannot carry it away fast enough. Some of it accumulates in the muscle cells, causing fatigue or soreness.

The cosmetologist can assist the patron in a program of exercise with the intelligent use of:

1. Manual massage (by hand or a vibrator)
2. Electric currents (special machines)
3. Light rays (ultraviolet or infra-red lamps)

Summary

1. Muscles move our bodies.
2. There are three types of muscles in the body: voluntary, involuntary, and cardiac.
3. An individual muscle is made up of fibers. These fibers are actually individual cells with more than one nucleus.
4. An individual muscle has three sections: the origin, the insertion, and the body.
5. Muscles are attached to bones by means of tendons.

Study Aids

Home–

Students can prepare reports on the following topics: muscles and their diseases; rehabilitation of injured muscles; methods of exercising the muscles.

Class–

Charts and diagrams depicting the muscular system are useful.

GLOSSARY
What Does It Mean?

Aponeurosis–a thick and deep fascia over a muscle and attached to the ends–flatter and thinner than a tendon

Abductor–a muscle that moves a part away from the midline of the body (e.g., moving the arms out to the sides)

Adductor–a muscle that moves a part toward the midline of the body (e.g., bringing the arms down to the sides)

Anterior–situated in the front, as an anterior muscle

Cardiac–in or of the heart, as cardiac muscle

Distal–farthest from the center, as distal muscles

Extensor–a muscle that moves a part out to make the joint angle larger

Fascia–a sheet of connective tissue covering a muscle, the ends of which lengthen into tendons, which are attached to bones

Flexor–a muscle that bends a part so as to make the joint angle smaller

Inferior–situated lower than something else

Involuntary muscle–a muscle which moves independent of the will

Lateral–at the side of something else

Medial–at the center

Nonstriated–not striped

Posterior–in back of, as a posterior muscle

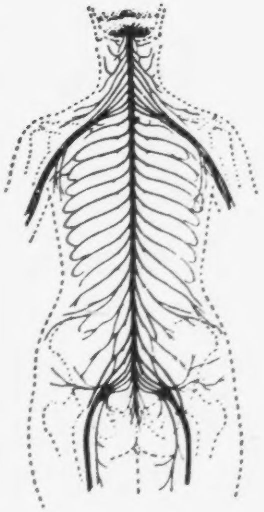
Myology–the scientific study of the muscular system

Superior–situated higher or above something else

Striated–striped

THE NERVOUS SYSTEM

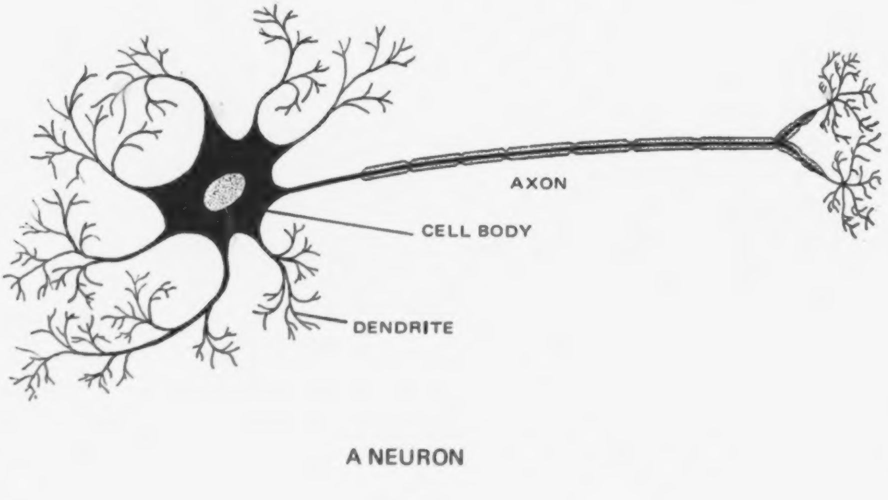
As is true with the rest of the body, the nervous system is made of cells. Because of the unusual nature of these cells, we give them special names. We call the cells of the nervous system *neurons.* Unlike other cells, a dead nerve cell can never be replaced. For this reason injury to the nerve cells in the brain means permanent injury to the brain. Normally the neurons in the brain are present at birth and last a lifetime.



SPINAL CORD AND SPINAL NERVES

There are billions of neurons in the body. There are some 12 billion in the cerebrum of the brain alone. A single neuron may be several feet long, but it cannot be seen without a microscope. Neurons are of three general types–sensory, connecting, and motor.

The nervous system has been compared to the telephone system. The central office–where connections are made between incoming calls and the parties to be reached–represents the brain, and the messages are carried over millions of "wires" bundled into "cables." These correspond to the nerves. The comparison is a very rough one, but you get the idea.



A NEURON

Every neuron has a *cell body* (which contains the nucleus), and most of the cell bodies lie within the brain or the spinal cord or near the spinal cord. Most neurons also have both long threads *(axons)* and branched threads *(dendrites)* that pick up and deliver the impulses. The long fibers are generally bundled up in the long threads called nerves. Nerves can be seen without a microscope.They lead to and from the skin, muscles, and body organs.

The impulses travel in *pathways* through the body. Some of these pathways are present at birth. Many more pathways are developed as the person grows and learns things–both bodily skills and mental ideas.

Let us take a simple example. You accidentally prick a finger. The nerve endings of a *sensory neuron* pick up the sensation and transmit the "message" to a *connecting neuron* located within the spinal cord. (The connection is not a physical one–the nerve endings are very near each other but not touching. This connection is called a *synapse.*) The connecting neuron relays the message immediately to *motor neurons,* which instantly stimulate the appropriate muscle fibers to contract and pull your arm away.

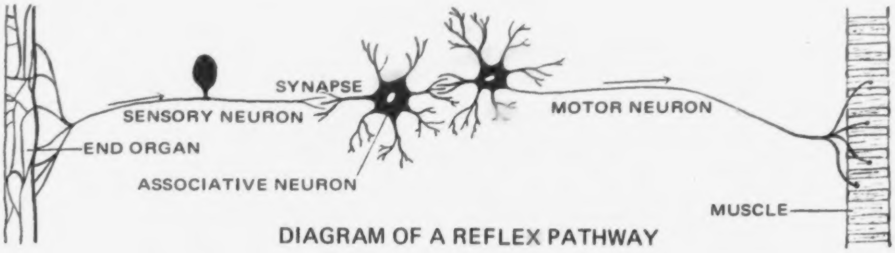
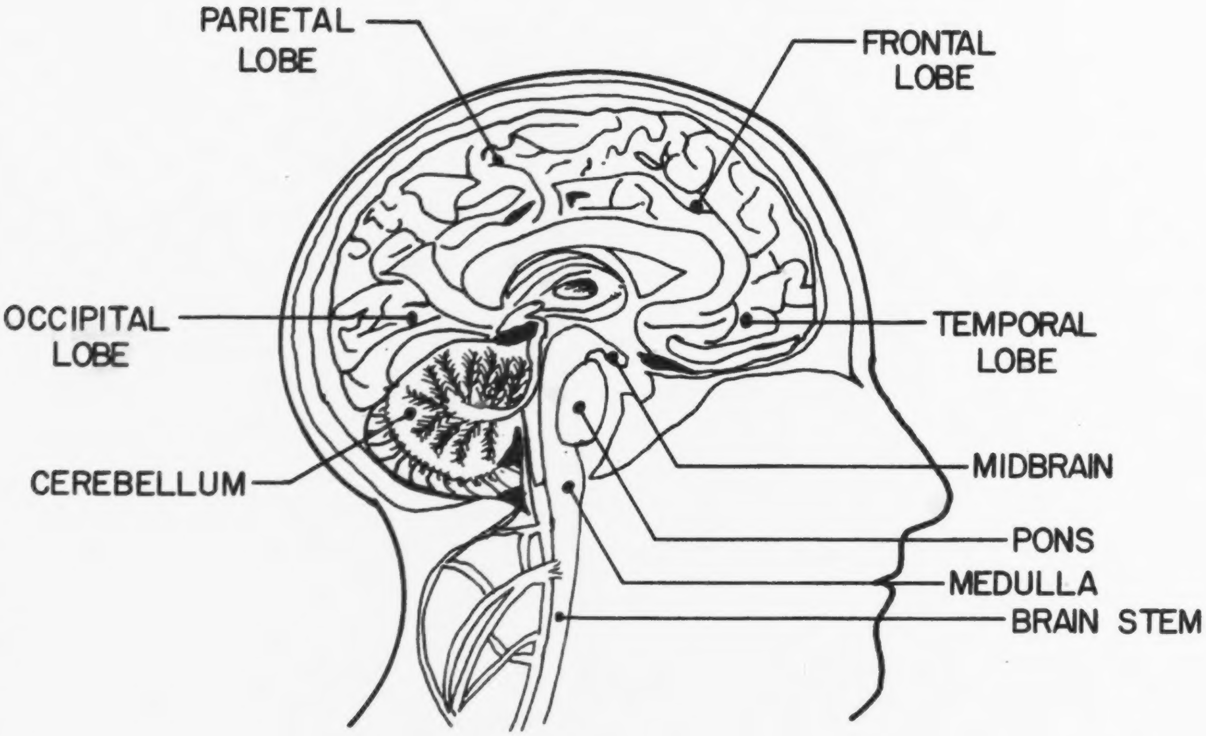


DIAGRAM OF A REFLEX PATHWAY

The above is an illustration of a *reflex action,* where the nerve pathway goes through the spinal cord for immediate action. The action is not instantaneous, however. There is a certain lag between the happening and your response – a small fraction of a second.

As the direct response is happening, however, the impulse is also traveling up the spinal cord by means of other neurons to various areas of the *brain.* When the brain gets the message, then you may become aware of pain, you may realize that you were careless, and you may start to *think* that you might need to apply an antiseptic.

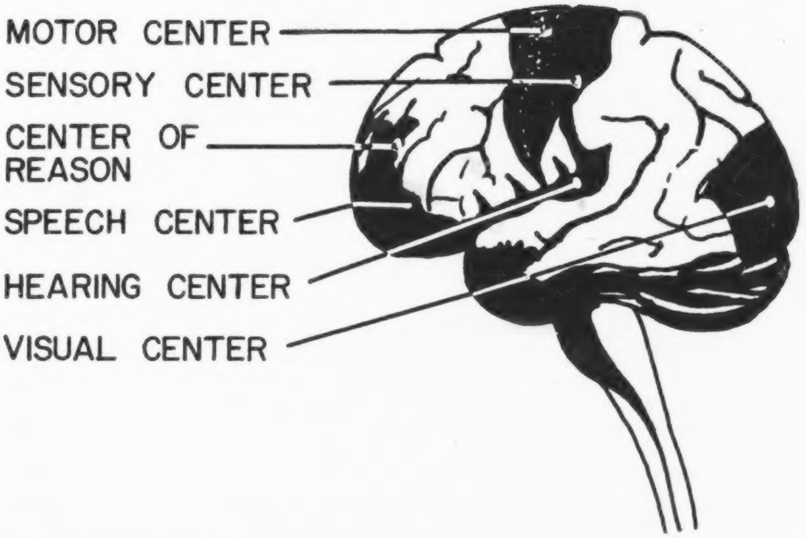
Sensory neurons start in the skin or the eyes or the ears. These are capable of transmitting impulses to any number of different motor neurons, because of the many dendrites that each neuron has. Since there are billions of neurons, you can imagine how many possible pathways there are. But in general, there is an incoming impulse, various connecting impulses–in brain or spinal cord or both– and outgoing impulses. When *thinking* and *feeling* are involved, a great many connecting neurons in the brain are needed. If you *decide* to do something, the pathway starts in the brain. This is called a *voluntary action.*



THE HUMAN BRAIN

The Brain

The brain is the most important part of the nervous system. It weighs about 44 to 48 ounces. The brain is divided into the following sections: the cerebrum, the cerebellum, the pons, and the medulla. The cerebrum is the largest area of the brain, forming the front and top portions. Different areas of the brain, called lobes, control important functions.



SPECIAL CENTERS OF THE BRAIN

The *cerebrum*, like the rest of the nervous system, consists of nerve cells and their fibers. By means of the cerebrum we think, see, hear, remember, feel emotions, make voluntary movements, and make decisions. It is the center of all the higher functions of the brain–our conscious behavior.

The *cerebellum* coordinates groups of muscles so that they work together smoothly. It helps maintain posture and balance.

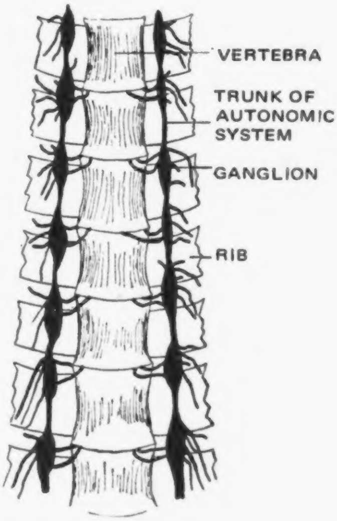
The *mid brain, pons*, and *medulla* lie at the top of the brain stem. They serve as passageways to the higher brain centers and provide some reflex reactions. The *medulla* in addition controls the heartbeat, breathing, and the enlarging and narrowing of the blood vessels, thus helping to control blood pressure. The medulla also controls chewing, sucking, blinking, and the action of some glands.

The nervous system is usually considered as composed of three parts:

1. **Central nervous system.** This part of the nervous system has often been compared to a computer. The brain and spinal cord are the parts of the central system. In those areas information is gathered and all "commands" are sent out.

2. **Peripheral nervous system.** This includes all of the message–sending neurons of the nervous system: sensory, motor, and connecting neurons. Most of the long fibers are bundled into the nerves.

3. The **autonomic (sympathetic) nervous system** consists of the lower portions of the brain, the lower part of the spinal cord, and two chains of nerve-cell groups (ganglia) that run down the spine but outside of it. The autonomic nerve cells, which are special motor neurons, connect these centers to the heart muscles, the smooth muscles of blood vessels and internal organs, and the glands. These operate without our thinking about them. Indeed, in most cases it is impossible for us to control our heartbeat, stomach muscles, glands, and the like.



PART OF THE AUTONOMIC NERVOUS SYSTEM

Summary

1. The main functions of the nervous system are to control the actions of the body and the thinking process.
2. Nerve cells are called neurons. "Nerves" are bundles of neuron fibers.
3. Most cell bodies are located in the brain or spinal cord or near the spinal cord.
4. Neurons are classified as sensory, motor, and connecting. Sensory nerves carry messages to the brain or spinal cord. Motor nerves carry messages from the brain, spinal cord, and ganglia to muscles, internal organs, and glands.
5. The nervous system consists of three parts: the central system, the peripheral system, and the autonomic system.
6. Nerve impulses follow established pathways through the body.

Study Aids

Home–

Crayon or pastel charts can be made, showing the parts of the nervous system.

Class–

Written and oral reports may be prepared on the following subjects:

a. The brain and its functions
b. Diseases of the brain (physical and mental)
c. How the brain "thinks"

Can you answer this?

1. What is a neuron? What does it consist of?
2. Where are sensory neurons located, and what is their function?
3. What are the three main parts of the nervous system and what does each do?
4. What is meant by a voluntary action?
5. What part of the nervous system controls:
    - voluntary actions
    - breathing
    - remembering
    - heartbeat
    - gland action
    - blood vessels
    - reflex actions
    - emotions
6. What do you think could be happening to the nerve pathways when a task (say toothbrushing) becomes more and more automatic, so that we no longer think about it?

GLOSSARY
What Does It Mean?

Autonomic nervous system—that part of the nervous system which controls the automatic functions of the body

Axon—the long, threadlike part of a neuron

Cerebellum—smaller, lower portion of the brain, controlling posture and balance

Cerebrum—large, top portion of the brain, controlling the higher processes and voluntary actions

Dendrites—short, branched fibers attached to nerve cells

Central nervous system—that part of nervous system which includes the brain and spinal cord

Ganglion (pl., ganglia)—a mass of nerve cell bodies outside the brain or spinal cord

Motor neurons–neurons that carry impulses from the brain, spinal cord, or ganglia to the point of action

Nerves–long cords which carry messages to and from the brain and spinal cord. They consist of bundles of neurons.

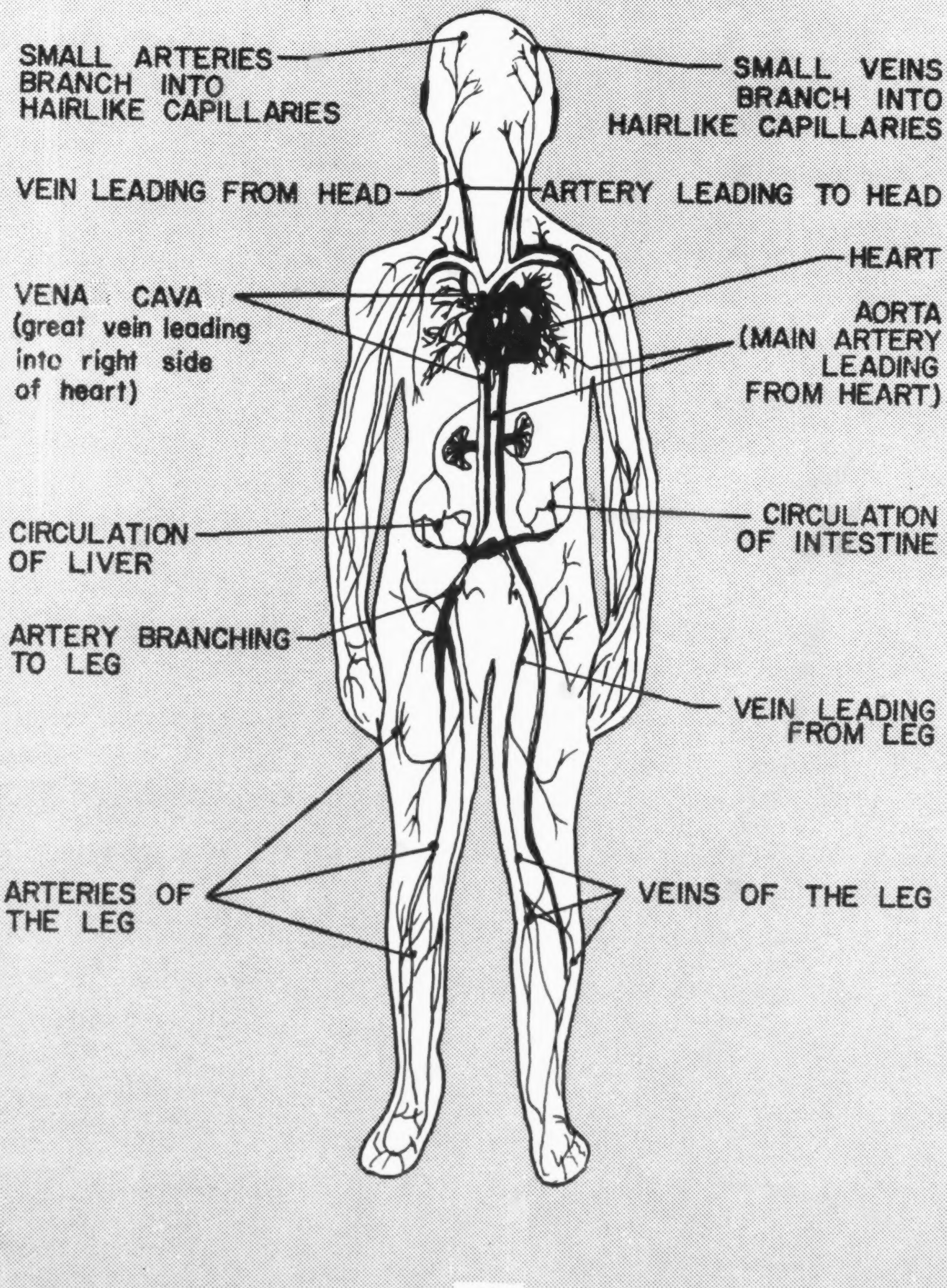
Neurology–the scientific study of the nervous system

Neuron–a nerve cell. It consists of cell body, axon, and dendrites.

Sensory neurons–neurons that carry impulses from some sense organ to the brain or spinal cord

Synapse–the connection between neurons

THE CIRCULATORY SYSTEM


SMALL ARTERIES BRANCH INTO HAIRLIKE CAPILLARIES
SMALL VEINS BRANCH INTO HAIRLIKE CAPILLARIES
VEIN LEADING FROM HEAD
ARTERY LEADING TO HEAD
HEART
VENA CAVA (great vein leading into right side of heart)
AORTA (MAIN ARTERY LEADING FROM HEART)
CIRCULATION OF LIVER
CIRCULATION OF INTESTINE
ARTERY BRANCHING TO LEG
VEIN LEADING FROM LEG
ARTERIES OF THE LEG
VEINS OF THE LEG

THE CIRCULATORY SYSTEM

By now you have grown familiar with the many different types of tissues in the body. It should not surprise you therefore, to learn that blood is a tissue also. Blood is tissue in liquid form. All other tissues of the body depend upon blood for their food and oxygen supply. Still, blood is only one part of the circulatory system. Blood and the ways in which it reaches the various parts of our body, will be our next topic of study.

The Parts of the Circulatory System

The circulatory system consists of:

1. The **heart**–which pumps blood to all parts of the body
2. A group of **blood vessels** which carry the blood
3. **Blood**–the precious liquid which sustains life
4. **Lymph and lymph vessels**–the important liquid which assists blood, and its supporting vessels.

The Heart

We have already learned that the heart is a type of muscle. In fact the heart is the strongest muscle in the body. Would you like to compare the muscle of your heart with the skeletal muscles of your body? You can: just clench and unclench your fist slowly and rhythmically. How long can you keep this up without getting tired? Yet your heart pumps once every second or so and only rests a fraction of a second between pumpings. In spite of this continuous pumping, 24 hours a day, 365 days a year, your heart (if not diseased) will last you a normal lifetime.

Structure of the Heart

The heart is pear-shaped. Each person's heart is about the size of his doubled-up fist. The heart lies in a slanting position with the smaller end pointing downward and toward the left. The *pericardium* is a thin, double-layered membrane (covering) which protects the heart. The heart has four sections called *chambers.* The two chambers on the left are separated from the two chambers on the right by a wall of muscle, and the blood cannot pass from one side to the other. Actually, the heart is a double pump. The right side receives the "used" blood from the body and pumps it to the lungs to get rid of carbon dioxide and pick up oxygen. Then this "renewed" blood enters the left side of the heart and is pumped to the rest of the body from there. Four valves keep the blood flowing in the proper direction.

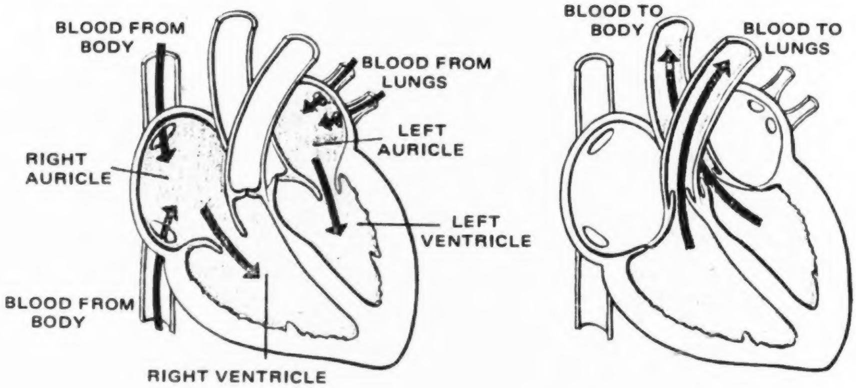


Diagram Showing Movement of Blood Through the Heart

Notice that the upper chambers are called *auricles* (or atriums) and the lower chambers are called *ventricles.*

Blood Vessels

Blood vessels transport blood to all parts of the body. There are three types of blood vessels:

1. **Arteries**

   The arteries are located deep within the body. They carry blood which has been purified by the lungs, away from the heart and to the parts of the body. Arteries are the largest of the blood vessels, and injury to them can cause serious damage to the individual. They divide into smaller and smaller branches to serve the various organs.

2. **Veins**

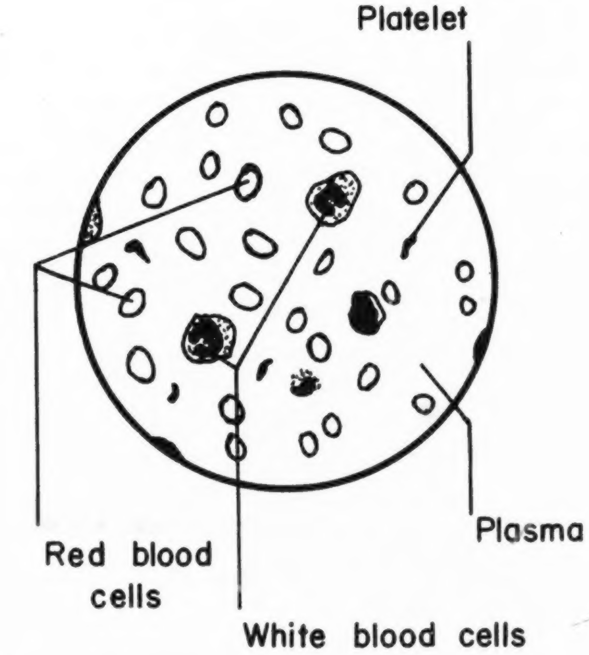
   Thinner than arteries, veins carry "impure" blood back to the heart, where it will be pumped to the lungs for purification. They also branch into smaller and smaller vessels. Many veins are closer to the surface than arteries.

3. **Capillaries**

   Smallest of the blood vessels, capillaries connect the smallest arteries with the smallest veins. Capillaries are microscopic in size. Their walls are only one cell thick. This allows food, oxygen, and wastes to pass through their walls and reach the body cells. Many capillaries are just below the body surfaces.

Blood

The average adult has about 6 quarts of blood in his system. If you could look at a drop of blood under the microscope, you would see a liquid called *plasma.* This liquid is 90% water, and the other 10% consists of various salts, digested foods, vitamins, hormones, carbon dioxide, and other cell wastes.



A DROP OF BLOOD

Also floating in the plasma are tiny specks called *platelets.* Platelets give blood its clotting power. Also in plasma are the *white blood cells* or leukocytes (LEW-kuh-sites). These cells move about the blood stream at will. They move out of the capillaries and collect in groups in a spot where disease germs have entered. While in battle against germs, many white blood cells die from the bacteria's poisons. Dead white blood cells are the main ingredient in pus.

Red Blood cells are the most numerous objects carried by the plasma – there are about 5 million red cells in one small drop of blood. There are about 600 red blood cells for every one white blood cell. The main function of red blood cells is to carry oxygen to the other body cells. This is done by the *hemoglobin* in the red cells. Hemoglobin takes up oxygen in the lungs and releases it to the tissues. It is the hemoglobin of the red cells that gives blood its red color.

Lymph

The circulatory system contains another important liquid called lymph. Lymph actually is produced from plasma. It filters out through capillaries, and surrounds each living cell. It is collected in lymph ducts or vessels; through these it makes its way back to the blood stream, entering it through veins in the neck region.

The lymphatic system is a network of these vessels. The contraction of body muscles keeps the lymph moving. Small bunches of tissue collect at certain points in this system. Properly called *lymph nodes,* you may have heard of them as lymph "glands," but this is incorrect. The lymph nodes filter out harmful substances such as bacteria. That is why, for example, the lymph nodes under the jaw will become swollen and sore if you have an infected tooth. The nodes have collected a lot of the germs. Thus they help the body fight infection. The lymph nodes also manufacture two types of white blood cells.

Summary

1. The circulatory system contains two important liquids—blood and lymph.
2. Blood is carried in tube-like passages called blood vessels.
3. Arteries, veins, and capillaries are the types of blood vessels.
4. Blood contains red blood cells, white blood cells, platelets, and plasma. Plasma is the liquid part of the blood.
5. The function of blood is to carry food, oxygen, and other necessary materials to all other body cells.
6. The heart, acting like a pump, pushes blood to the lungs and through all the blood vessels of the body.
7. White blood cells kill and "eat" many germs that have gotten into the body.
8. The hemoglobin of the red blood cells carries oxygen to the body cells.
9. Lymph helps to remove bacteria and other harmful substances that have entered the body before they can get into the blood stream.

Study Aids

Class–

Volunteers can go to the chalkboard and draw diagrams of the heart. Students can orally explain blood circulation in the heart. Mock-ups of the heart may be shown in class.

Home–

Reports may be prepared on the following subjects:

1. Blood pressure
2. Heart disease

GLOSSARY
What Does It Mean?

Aorta–the large artery which carries blood away from the heart for circulation to the body organs

Artery–thick-walled blood vessels that carry blood to the organs

Auricles– the two top chambers of the heart

Capillaries–microscopic blood vessels that connect the smallest arteries with the smallest veins

Lymph–a liquid derived from plasma that surrounds all the cells of the body

Hemoglobin–a red, complex chemical substance which carries oxygen from the lungs to the cells

Heart–the pear-shaped muscle organ which pushes blood in the manner of a pump, through the blood vessels

Leukocytes–white blood cells

Pulmonary artery–artery which carries blood from the heart to the lungs

Pulmonary vein–vein which carries blood from the lungs to the heart

Vena cava–main vein leading to the heart

Valves–tiny door-like objects which open to allow blood to spurt from one heart chamber to another

Pericardium-two thin membranes which cover and protect the heart

Veins–blood vessels which carry blood to the heart

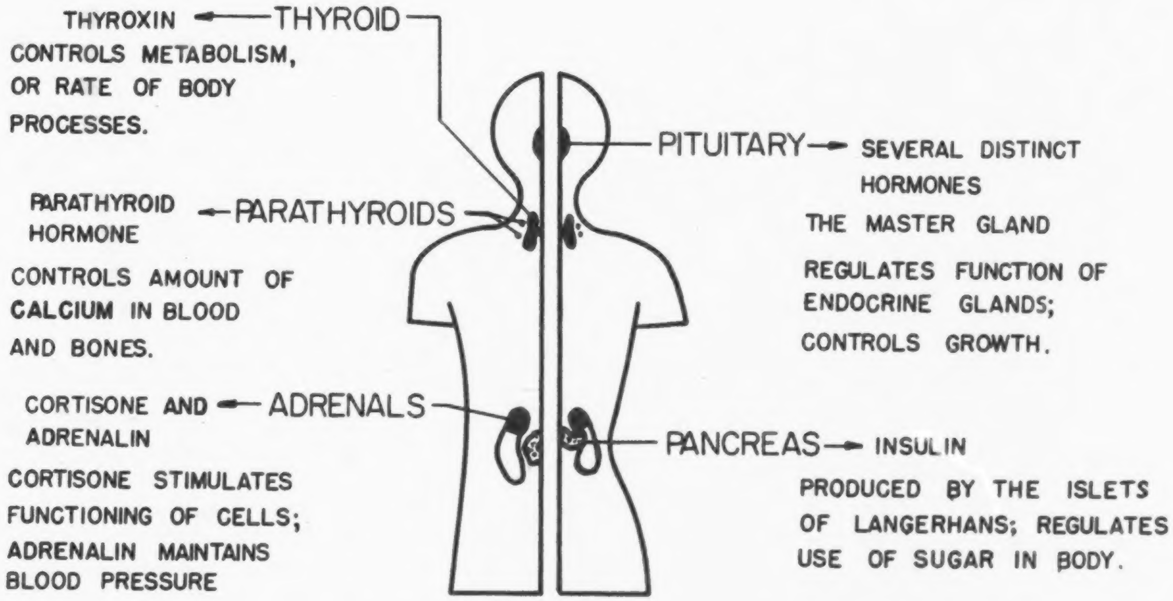
Ventricles–the two lower chambers of the heart

THE ENDOCRINE SYSTEM

By now we have become aware of the marvellously complicated nature of our bodies. We begin to realize that some controls are needed to keep all the many organs and systems working as they should. This is the function of the endocrine (end′-o-krin) system.

Structure

The endocrine system consists of a *group of ductless glands (glands without tubes) which manufacture chemical substances called hormones.* The glands secrete these substances directly into the blood stream, from which they reach the organs and cells they need to reach. Hormones aid in regulating the activities of the cells of the body. Shown below are the main ductless glands of the endocrine system, and some of their functions. Not shown are the sex glands which in addition to producing eggs or sperm, also make hormones that directly enter the blood stream and produce the various sex characteristics of women and men.


THYROXIN ← THYROID
CONTROLS METABOLISM, OR RATE OF BODY PROCESSES.
PARATHYROID HORMONE ← PARATHYROIDS
CONTROLS AMOUNT OF CALCIUM IN BLOOD AND BONES.
CORTISONE AND ADRENALIN ← ADRENALS
CORTISONE STIMULATES FUNCTIONING OF CELLS; ADRENALIN MAINTAINS BLOOD PRESSURE
PITUITARY → SEVERAL DISTINCT HORMONES
THE MASTER GLAND
REGULATES FUNCTION OF ENDOCRINE GLANDS; CONTROLS GROWTH.
PANCREAS → INSULIN
PRODUCED BY THE ISLETS OF LANGERHANS; REGULATES USE OF SUGAR IN BODY.

THE ENDOCRINE GLANDS

Thyroid Gland

This gland is located in the neck. *Thyroxin* is the hormone produced by the thyroid gland. Thyroxin controls the rate at which the cells of the body convert food into energy. We call this process *metabolism.* Because thyroxin controls our metabolism, it also influences our body weight. Normal mental and physical growth also depend upon a thyroid's functioning normally.

Pituitary Gland

This is often called the master gland. Locate at the base of the brain, this pea-size gland is really two endocrine glands, which together secrete nine different hormones. Some of them act on other glands to keep them working properly. One of the hormones speeds up tissue-formation from proteins and so regulates the growth of the body. Too much of this hormone during childhood causes a person to be abnormally tall. Too little of this hormone causes a person to be abnormally small.

Adrenal Glands

The adrenal glands are curved over the top of each kidney. Each gland is really a double gland also. One part produces the hormone called adrenaline. Adrenaline helps the body handle stress situations by speeding the heartbeat and blood circulation, releasing extra sugar into the blood for more energy, etc. The body becomes capable of great physical effort. Science has been able to artificially create adrenaline. This synthetic product is called Adrenalin. Adrenalin has been used to stimulate the heart in cases of heart attack and to relieve asthma attacks.

The other part of the adrenal glands secretes several hormones called *corticoids* (cortisone and others). These are vital to the proper functioning of all body cells, enabling them to carry on normal metabolism of proteins, fats, and carbohydrates.

Pancreas

Most of the pancreas, a large gland located under the stomach, produces disgestive juices. However, scattered throughout the pancreas are little clusters of cells that produce the hormone *insulin.* Insulin controls the amount of sugar absorbed by the cells from the blood stream. Too little insulin results in a disease called diabetes, where the sugar level in the blood may rise to three or more times the normal amount.

Parathyroid Glands

The hormone secreted by the parathyroid glands has a life-or-death effect. It influences the chemistry of the blood by causing calcium to leave the bones and enter the blood. When there is too much or too little calcium in the blood, a person can become mentally disturbed, or have muscle spasms, or even die.

Summary

1. The function of the endocrine system is to regulate the cells, organs, and systems of the body.
2. The endocrine system is made up of ductless organs called glands.
3. The ductless glands produce chemical substances called hormones, which are released directly into the bloodstream.

Study Aids

Class–

Oral reports explaining the new discoveries about hormones are interesting.

Can you answer this?

1. List the endocrine glands.
2. What is the function of thyroxin?
3. What is the function of insulin?
4. Which is called the master gland? Why?
5. What is the function of adrenaline? What else do the adrenal glands secrete?
6. Which glands could the body get along without?

GLOSSARY

What Does It Mean?

Adrenaline–or epinephrine, the hormone produced by the inner part of the adrenal glands. The synthetic chemical (Adrenalin) is used to stimulate the heartbeat.

Ductless gland–A gland which empties its secretion directly into the bloodstream, without the aid of tubes called ducts

Hormone–a complex chemical which is produced by ductless glands

Insulin–a hormone produced by the pancreas

Metabolism–the complicated process by which cells utilize food

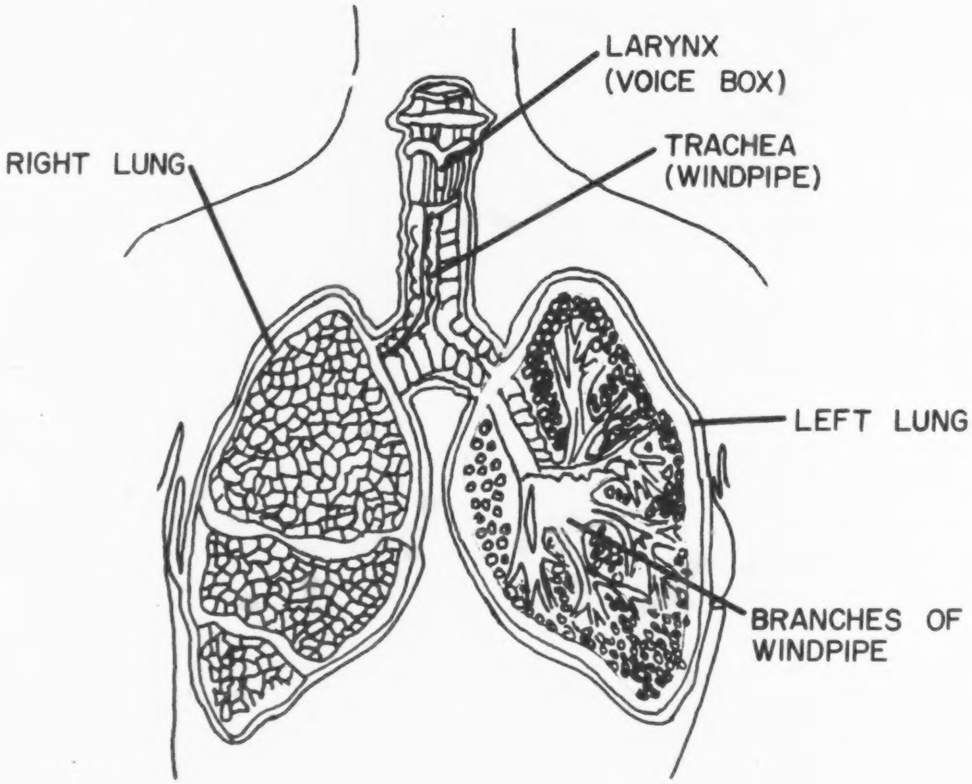
Thyroid–one of the endocrine glands

Thyroxin–the hormone of the thyroid gland, which controls metabolism

Pancreas–one of the endocrine glands

Pituitary–one of the endocrine glands, aften called the master gland

THE RESPIRATORY SYSTEM



We have learned that all cells need food and oxygen to survive. We also know that blood carries these ingredients to the cells of the body. We should now ask, how does the blood obtain its oxygen supply? The answer, of course, is by means of a respiratory system. The parts of the respiratory system are as follows: the lungs, nasal passages, pharynx, trachea, bronchial tubes, and diaphragm.

The Lungs

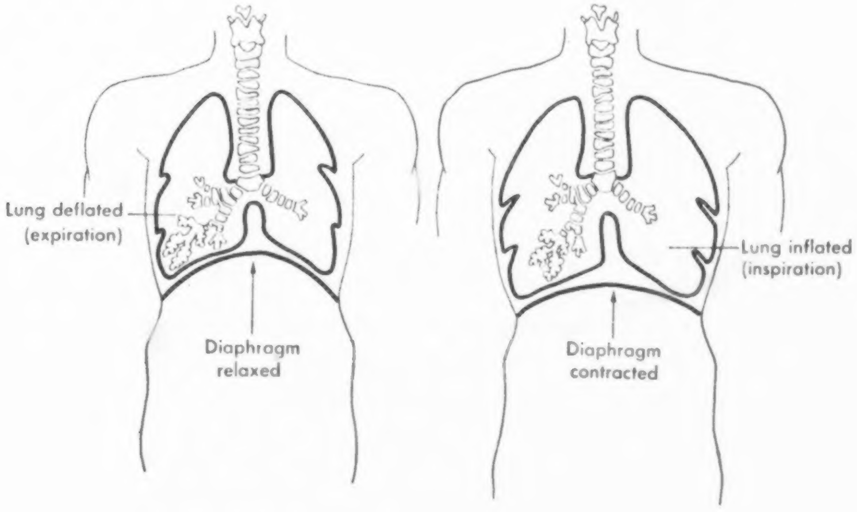
The lungs are made of spongy-type tissues. Each lung is filled with millions of tiny air sacs which get bigger as they become filled with air. Around each sac is a tight-fitting network of capillaries. When we breathe, air comes into the air sacs. The oxygen present in the air passes through the air-sac membranes and the capillary membranes into the capillaries. At the same time, the carbon dioxide in the blood (a waste product) passes through the membranes in the opposite direction. The result is that, with each breath, the blood gains oxygen and loses carbon dioxide. The "used" air passes from the lungs through the trachea and out through the nasal passages.

The reverse process takes place within all the other tissues of the body. The waste carbon dioxide passes out through the cell walls and into the capillaries, while oxygen passes from the blood into the cells.

Breathing

Did you ever wonder why humans have hairs on the inside of the nose? You may have guessed that the hairs were there to assist in filtering out dirt particles from the air we breathe–and you have guessed right. The passage of air through our nose is step number one in healthy breathing. The warmed air enters the pharynx (fah-rinks), the throat cavity at the back of the mouth. From here the air goes into the windpipe or trachea, a long tube leading to the bronchial tubes. The air moves through the trachea and into two bronchial tubes, one on the left side, one on the right side. Both bronchial tubes enter into large sacs we call the left and right lungs. Once the air is in the lungs it is absorbed into the air sacs.

The lungs, unlike the heart, are not made of muscle tissue. They are able to inflate and deflate only with the aid of the diaphragm and the muscles in the chest cavity which operate the rib cage. The diagram below shows this action.



Summary

1. The function of the respiratory system is to obtain an oxygen supply for our body cells.
2. The parts of the respiratory system are: Nasal passages, lungs, pharynx, trachea, bronchial tubes, and diaphragm.
3. The lungs contain tiny air sacs which expand and deflate as we breathe.
4. In the lungs, oxygen passes into the capillaries while carbon dioxide passes out of them.
5. In the tissues, the opposite takes place, and the cells get a fresh supply of oxygen.

Study Aids

Home–

Reports may be prepared on the following subjects:
Smoking and lung cancer
Diseases of the lungs (tuberculosis, etc.)

Can you answer this?

1. List the parts of the respiratory system.
2. Trace the flow of air from when it first enters the nasal passages until it finally leaves the body.
3. Tell what happens within the air sacs of the lungs.

GLOSSARY

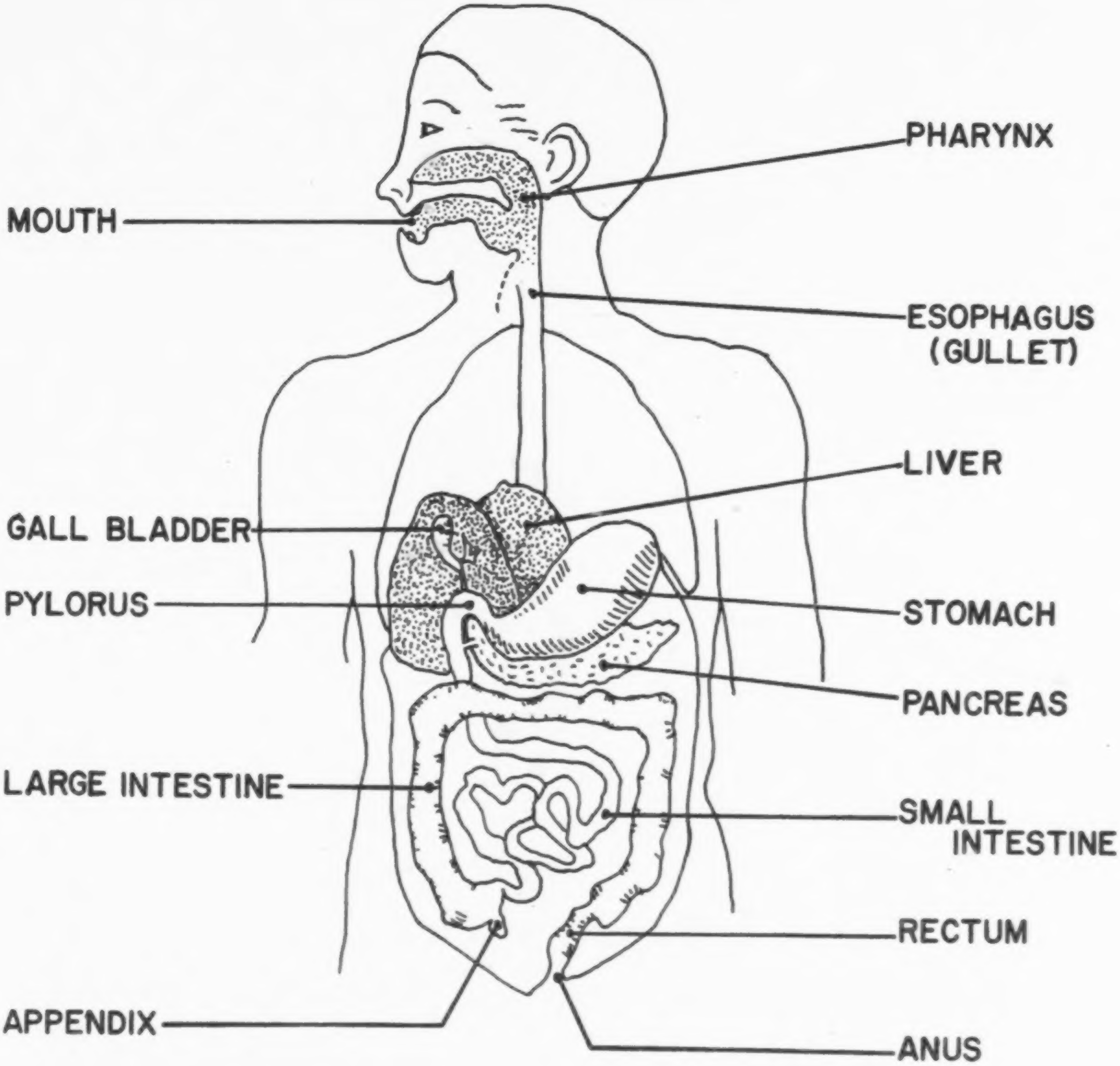
What Does It Mean?

Abdominal breathing–deep breathing with the use of the diaphragm

Costal breathing–shallow breathing

Carbon dioxide–a gas which is an end product of the cells' use of food and oxygen to produce energy

THE DIGESTIVE SYSTEM



Our bodies need a certain amount of food. This food must eventually feed our microscopic cells. How can a solid object—a steak or apple, for example—enter our body cells? These objects must be broken down into simpler forms that can nourish the body cells. The function of the digestive system is to *change the food we eat into simpler substances that can pass through the body membranes and be used by the cells.* To do this, the system uses both mechanical action (chewing, mixing and churning) and chemical action.

Parts of the Digestive System

The main parts of the digestive system are the mouth, esophagus, stomach, and small intestine. Then there are the salivary glands, liver, gallbladder, and pancreas. Most digestive organs produce complex chemicals called *enzymes. Enzymes are important chemicals which aid in the breaking down of food.*

The Mouth

The first step in the process of digestion is the entering of food through the mouth. We will use an ordinary sandwich as our example. The teeth are the first objects to attack the sandwich, tearing it into small bits. At the same time, a juice called *saliva,* produced by the *salivary glands* in the mouth, mixes with the pieces. The saliva itself contains an enzyme called *ptyalin* (ty′-uh-lin). Ptyalin has the ability to start digesting the starch of the bread by changing it to a type of sugar. The food bits now pass through the *esophagus,* a long pipe, into the *stomach.*

The Stomach

In the lining of this bag-shaped muscular organ lie millions of gastric glands. From these come the enzymes *pepsin* and *rennin,* together with very dilute hydrochloric acid. These start to break down the protein in the foods into somewhat simpler forms. Food remains in the stomach for about 3 to 4 hours, where it is constantly churned (mixed). During this time, proteins are partly digested. The almost-liquid mass is passed along to the small intestine.

The Small Intestine

Most digestion takes place in the small intestine. The small intestine is a tube which in an adult measures about 20 feet long and one inch across. Food remains in the small intestine, being slowly churned and moved along, for about 8 hours. Several digestive juices enter the intestine at its upper end. These include *bile,* made by the *liver* (and stored in the gallbladder) and *pancreatic juice,* made by the *pancreas.* The bile works on fats, and the several enzymes in pancreatic juice work on fats, proteins, and starches. Then there are several enzymes secreted by glands in the lining of the small intestine itself, which mix with food and complete the job of digesting the foods.

The final result of all of this is that the starches are changed to simple sugars, proteins to amino acids, and fats to simpler products. These fully digested products pass through the lining of the small intestine and into the blood and lymph capillaries there. The digested bits are carried by the blood to all parts of the body. Our sandwich is now in a form where the body cells can use it to build and repair tissue and supply energy.

Summary

1. The function of the Digestive System is to break down foods into simple forms that can be absorbed into the blood and into the cells.
2. The digestive organs are mouth, esophagus, stomach, and small intestine.
3. Enzymes are chemicals produced by the digestive organs which aid in the breaking down of foods.
4. Enzymes are made by the salivary glands, stomach-lining glands, pancreas, and intestinal - lining glands.
5. The liver makes bile, for the digestion of fats.

Can you answer this?

1. What is an enzyme?
2. What are the two kinds of actions in the digestive process?
3. List the parts of the digestive system.
4. What is the fully digested form of starches? of proteins?

THE EXCRETORY SYSTEM

It is a good bet you are one step ahead of us by now. You are probably thinking about the food we digested and what happens to the rest of it after its valuable parts have been digested. Very simply, it is now time for a group of organs which make up the excretory system to do their jobs. The function of the excretory system is *the removal of body wastes.* If this is not done, the body can be poisoned. The parts of the excretory system are the lungs, skin, kidneys, and large intestine.

Lungs

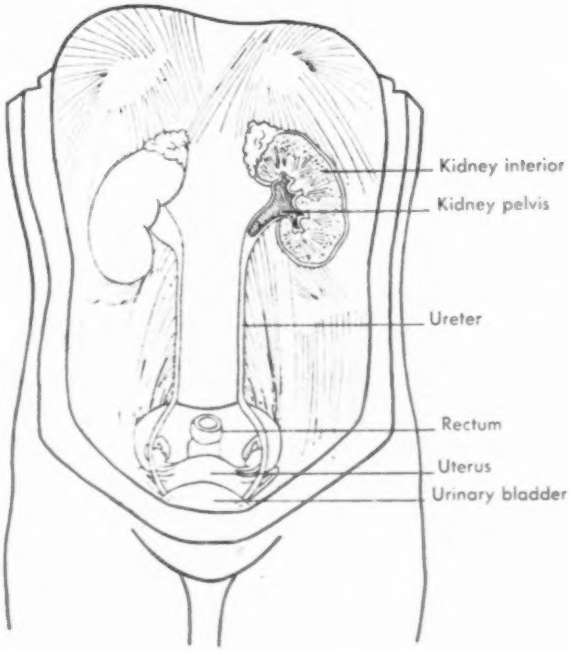
The lungs remove carbon dioxide from the body. For this reason the lungs are part of both the respiratory system and the excretory system.

The Skin

The skin is actually a large continuous organ. It has many tiny openings called pores. Pores permit liquid waste called sweat (or perspiration) to escape the body. Sweat contains a little urea (waste from protein), quite a bit of salt, and lots of water.

The Kidneys

The kidneys remove urea, salt, and other waste products from the blood, and these wastes, dissolved in water, are stored in the *bladder. Urine* is the term for this type of liquid waste.



The Large Intestine

The large intestine is the temporary storage place for solid wastes which are left over after the food has been digested. Most of the water from the food passes through the walls of the large intestine and into the blood stream. The body has no further use for the material that is left (feces), and it is expelled through the opening of the *rectum*, called the *anus.*

Summary

1. The function of the excretory system is to remove wastes from the body.
2. The parts of the excretory system are the lungs, skin, kidneys, and large intestine.
3. Sweat and urine are liquid wastes.
4. Solid wastes (feces) are stored in the large intestine before they leave the body.

Can you answer this?

1. List the organs of the excretory system.
2. Name the types of liquid wastes.
3. What is the function of the skin as part of the excretory system?

GLOSSARY

What Does It Mean?

Bladder–the organ which stores urine

Esophagus–the gullet or food pipe. Here, the food is transferred from the mouth to the stomach.

Enzymes–special chemicals produced by certain digestive glands which are used by the body to break down food into simpler substances

Pores–tiny openings in the skin

UNIT IV – THE SKIN

Introduction

Most of us have noticed there is a definite connection between the state of our health and our outward physical appearance. In other words, individuals who are well, appear well to others. One of the first requirements for a healthy and attractive appearance is a healthy skin. Let us examine the structure of skin with the aim of answering these questions:

1. How do we define skin?
2. What are the functions of skin? (Why is skin important?)
3. How is skin maintained?

At the end of this unit you will be able to answer these questions and most other questions that your future patrons might ask you in the beauty shop.

Functions of the Skin

The skin is an organ. Hard to believe? You might say it is not like other organs we have studied, such as the heart or the stomach. Yet the skin is an organ just as these other body parts are. Instead of being compact and taking up very little space, the skin serves as a covering for the entire body. Without this tough covering, germs would have a much easier time getting into the body. This gives us the first function of skin: *(1) The skin covers and protects our body.*

The skin has many layers. One of its layers contains coloring matter, a pigment called melanin (mel'-uh-nin). *(2) The skin determines the color of our body.*

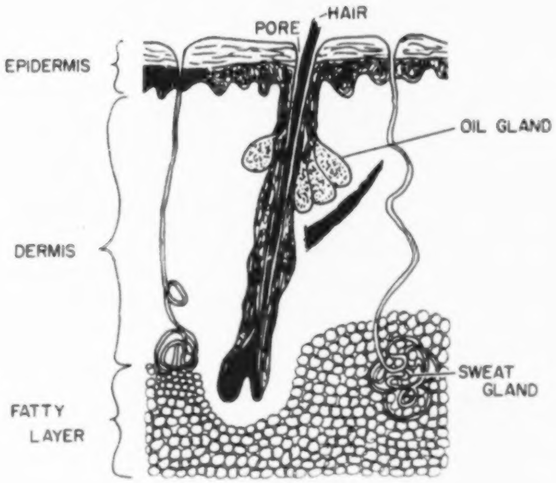
Another layer of our skin produces cells which fight off the effects of water on our body. *(3) The skin is a "waterproofer."*

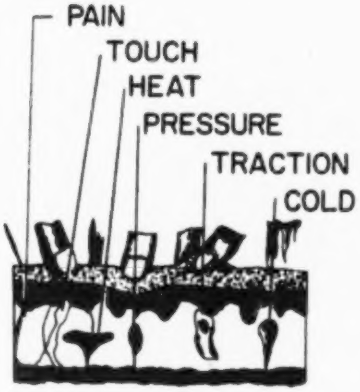
The skin, and its layer of fat below, tend to keep in the body heat in cold weather, and the sweat glands of the skin help control the amounts of water and heat lost from the body. *(4) The skin helps to control our body temperature.*

Other layers of skin allow us to feel pain, or react to pressure. *(5) The skin contains many sense organs.*

Some liquid wastes in the body escape through the tiny openings of the sweat glands, called pores. *(6) The skin aids in excretion.*

There is one more function of skin. *The skin produces vitamin D when exposed to sunshine.*





NERVE ENDINGS IN THE SKIN

Structure of Skin

The skin has two main layers, each which is itself divided into smaller layers.

Epidermis (ep-i-DER-mus)

The outer layer of skin is the epidermis. The epidermis is divided into four thinner layers, one on top of another. The soft cells at the bottom layers of epidermis move up layer by layer, at the same time becoming harder. By the time the cells reach the top layers at the skin surface they are hard, and it is these hard cells which finally flake off as dead skin. As this happens, new cells from beneath the surface take their place, and the procedure goes on continuously. The layers of the epidermis are:

1. The Corneum

This is the outermost layer of the epidermis. The corneum is sometimes called the *horny* or *sharp* layer, due to its hard cells. Millions of corneum cells die each day. These dead cells flake off and are immediately replaced by new cells. Try this--using your index finger, rub the back of your arm. Do you realize that you have just wiped off thousands of tiny dying or dead cells? The corneum contains *keratin*, a tough, fibrous protein substance which waterproofs our skin.

2. The Lucidum (LU-si-dum)

Directly under the corneum is the lucidum. The cells of this layer are transparent and allow light to pass through into the deeper portions of skin.

3. The Granulosum (gran-yuh-LO-sum)

This layer is directly underneath the lucidum. These cells resemble granules or specks. It is here that the softer cells undergo chemical changes in order to become horny cells so that they may provide the protection that is needed at the skin surface.

4. The Germinativum (jer-min-AY-tiv-um)

The word "germinate" means to start to grow. This layer is the deepest layer of the epidermis. It has several important jobs. It is in this layer that cells begin to grow. As they increase in number, they move outward toward the surface of the skin. Melanin is found in this layer.

The Dermis (DER-mus)

The second main layer of the skin is called the dermis. The dermis is sometimes called the true skin, because most of the important tiny organs of the skin are located there. The dermis has two layers:

1. The Papillary layer (PAP-uh-lary)

The papillary layer is directly under the last layer of the epidermis. It is an uneven layer, shaped like many small hills and valleys. The cells of this layer resemble fibers and give skin its elasticity. The sense of touch is located in this layer.

2. Reticular layer (reh-TIK-yuh-ler)

The reticular layer makes up the inner portion of the dermis. It contains the hair roots, oil glands, sweat glands, and nerve endings for our senses of heat, cold, pressure, and others. Blood vessels which feed the skin are located in the recticular layer.

Earlier we discussed ductless glands. Now we find that the skin contains glands also. However, the glands of the skin have ducts and are very much smaller than other glands in the body. A duct is a tube connected to the gland. These tubes carry certain chemicals to the skin surface. The chemicals pass through the skin surface through tiny openings called pores, and through openings at the base of the hair shaft.

The technical term for a gland which produces oil is a *sebaceous* gland. The technical term for oil is *sebum*. Sebum keeps the hair and skin soft. The technical term for the gland which send sweat to the surface is the *suderiferous* gland. The function of sweat is to keep our bodies cool and to get rid of liquid body wastes. Both sebaceous and suderiferous glands are located in the reticular layer of skin. Sebaceous glands are unusual in that they actually lie next to the hair follicle (long thin pathway) beneath the skin surface. The duct of the sebaceous gland rises as the hair grows, and the sebum empties alongside of the emerging hair. Thus the glands lubricate the hair as well as the skin.

Fatty Tissue

Besides our epidermis and dermis, we have a layer of fatty tissue underneath our skin surface. This fatty tissue lies directly under the reticular layer. The technical term for fatty tissue is *adipose* tissue. This tissue varies in thickness according to the individual–as you can see when you look at people around you.

Summary

1. The skin is the largest organ of the body.
2. The functions of the skin are to:
   ––cover, shape, and protect the body
   ––determine the color of the body
   ––waterproof the body
   ––carry the sense organs
   ––help control body temperature
   ––furnish the body with Vitamin D
   ––help to excrete body waste
   ––give us an attractive appearance
3. The skin has two main layers: the epidermis and the dermis.
4. The epidermis consists of 4 layers.
5. The dermis consists of 2 layers.
6. Adipose tissue is fatty tissue which lies under the dermis layer.
7. Hair and nail are not skin but are attached to skin and have much the same chemical makeup.

Study Aids

Class–

It is possible to see human skin cells if a powerful microscope is available. Use dead scales from the scalp or from under the finger nails, or the hard skin from a callous. Place this skin under a microscope and look for the cells.

Can you answer this?

1. List 4 functions of the skin.
2. What is the term used for the coloring pigment in skin?
3. Which layer of epidermis contains a waterproofer?
4. Which layer of dermis contains the sensations for heat and cold?
5. What is an unusual characteristic of the cells of the epidermis?
6. Name two types of glands located in the skin. Tell the function of each.

COMMON SKIN PROBLEMS

Diseases and Disorders of the Skin

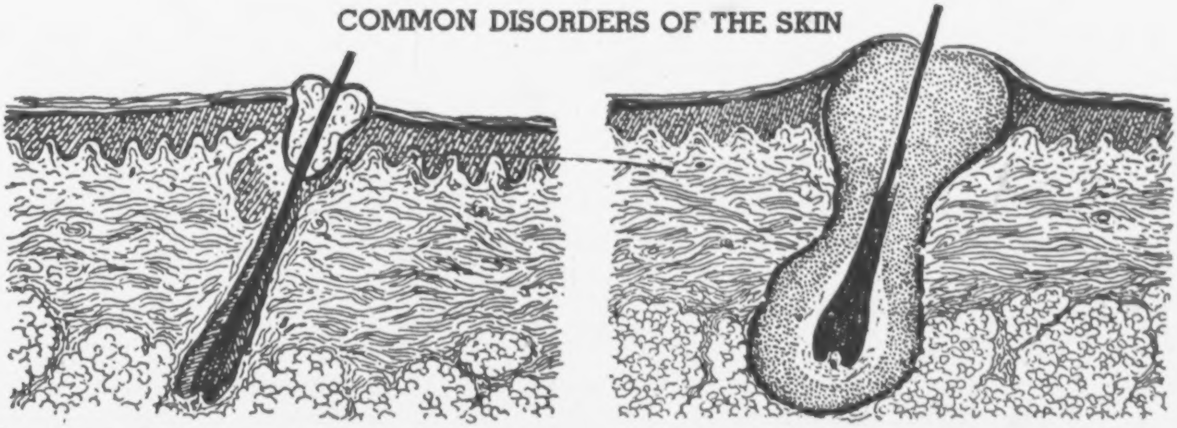
As a student cosmetologist you no doubt have taken special notice of persons who have skin problems. We can put skin problems into two major classes, diseases and disorders. For our own purposes we define a *disease* as *a skin problem which is usually more serious and should always be treated by a physician.* A *disorder* will be defined as *usually less serious and may or may not require the services of a physician.* Skin problems can attack any area of the body, but we are most concerned with the diseases and disorders of the oil and sweat glands as they affect the head and face. A person suffering from the following conditions to the extent of discomfort should see a dermatologist (skin doctor).

Diseases and Disorders of the Sebaceous Glands

Blackheads (comedones–kom-uh-DO-neez)

These unsightly objects are actually hardened bits of sebum combined with dirt and bacteria. When too much oil is produced by the sebaceous gland, the excess spills over onto the skin surface. When this happens often enough and the affected area becomes irritated, we say *acne* is present.

COMMON DISORDERS OF THE SKIN



Acne vulgaris. Notice plug, or "blackhead," around mouth of hair follicle

Folliculitis, infection of hair follicle

Acne

Acne is a chronic skin disorder marked by blackheads, pimples, cysts, and scarring. The cause of acne is believed to be a type of germ, but we know definitely that acne is aggravated by nervousness, poor diet, digestive problems, and the glandular changes that come with adolescence.

What can we do about acne? Doctors agree that you can help heal a condition of acne by following some simple rules. (For a professional face treatment, see text on practical work.)

1. Wash the affected areas two or three times a day with your own washcloth or *soft* brush.
2. Dry with a *rough* towel.
3. Avoid picking at the affected areas.
4. Avoid greasy creams or salves.
5. Remove blackheads with a comedo extractor, first being sure that the area has been softened with hot towels for 15 to 20 minutes. (This will open the pores).
6. Sun bathing may help, but this should be done sparingly, as the ultraviolet rays can do as much harm as good.

Steatoma (stee-a-To-muh)

An unsightly condition most often affecting the scalp, neck, and back areas. Symptoms are a growth or several growths, varied in size, resembling closed sacs or cysts. These sacs contain sebaceous matter.

Seborrhea (seb-uh-REE-uh)

Seborrhea is another disease caused by a malfunction of the oil glands. Again in this case the gland overproduces oil, and oil settles on the skin surface. Itching and burning occur, and the affected area takes on a shiny or glossy appearance. Seborrhea usually strikes the nose, forehead, and scalp.

Asteatosis (a-stee-a-TO-sis)

Here is the opposite of seborrhea. Asteatosis is a condition of too little oil. The symptoms are dry, scaly skin.

Whiteheads (milia–MIL-ee-uh)

Sebaceous matter combined with certain fluids make up these troublesome, light-colored cysts.

Diseases of the Suderiferous Glands

As with oil-gland diseases, any disease of the sweat gland should receive medical help. Some common sweat-gland diseases are:

Bromidrosis (bro-meh-DRO-sis)

Symptom is foul-smelling perspiration. This is usually most noticeable at the armpits or feet.

Anidrosis (an-eh-DRO-sis)

A lack of perspiration. Since perspiration is liquid waste leaving the body, this condition can be very serious.

Lesions

Some skin diseases cause lesions to break out. A *lesion* is any change in the normal structure of the skin. An example of this is found in the condition of acne. Acne may cause lesions in the form of pustules, scales, etc. Some common lesions are:

Acne Pustulosa

1. Pustule–an inflamed, raised portion of skin containing pus (e.g., the common pimple)
2. Vesicle–a blister with clear fluid
3. Wheal–an itchy, swollen lesion which lasts only a few hours
4. Scale–a dry or greasy flake, such as dandruff
5. Crust–a mixture of pus and skin material
6. Ulcer–any abnormal opening or break in the skin covering. Pus is usually present.
7. Fissure (fish-ure)–a thin crack in the skin (as in chapped lips or hands)
8. Excoriation (eks-kore-A-shun)–a sore received from scraping or scratching one's self

Other Skin Diseases

Some skin diseases, though not affecting the general health of the individual in a serious way, are annoying due to their unsightly and uncomfortable symptoms. Below are some diseases of this type.

Psoriasis (suh-RY-uh-sis)

This chronic (recurring) disease not only affects the scalp but strikes the back of the elbows, front of the knees, chest, and back. Psoriasis and seborrhea often occur together. The symptoms of psoriasis are dry, silvery scales, either in patches or sheet-like formation. No cure is known, but control is possible. So far as is known, psoriasis is not contagious.

Tinea (ringworm)

A skin disease caused by a plant parasite. For a discussion of this disease turn to page 92.

Eczema (ig-ZEE-muh or EK-seh-muh)

Several diseases are called eczema, and therefore eczema has many symptoms. The true case of eczema begins with redness and water blisters as the first stage. "Weeping" of the skin may be present at this stage. In the second phase, scratching results in the breaking of blisters and the forming of crusts and scales. Later in the disease a thick, hard surface appears and itching increases. The condition is unsightly but not contagious.

Herpes Simplex (HER-peez SIM-plex)

This disease is a highly inflamed condition commonly known as a fever blister or cold sore. These vesicles form in groups on the lips and nostrils and usually last for seven to ten days. A virus is believed to be the cause.

Summary

1. Skin disorders are usually less serious and may or may not require medical attention. Skin diseases are usually more serious and should receive medical attention.
2. The diseases of the sebaceous glands are: blackheads, acne, seborrhea, asteatosis, steatoma, whiteheads.
3. The diseases of the suderiferous glands are: bromidrosis and anidrosis.
4. Lesions are caused by skin diseases.
5. A lesion is any change in the ordinary structure of the skin.

Study Aids

Class– Any students who have had a favorable experience in overcoming acne might tell the class about it.

Can you answer this?

1. List the diseases of the sebaceous glands.
2. Give the symptoms of seborrhea.
3. What is bromidrosis? Describe it.
4. Describe the symptoms of asteatosis.
5. A lesion is any change in the ordinary structure of the skin. Name 5 lesions.

GLOSSARY

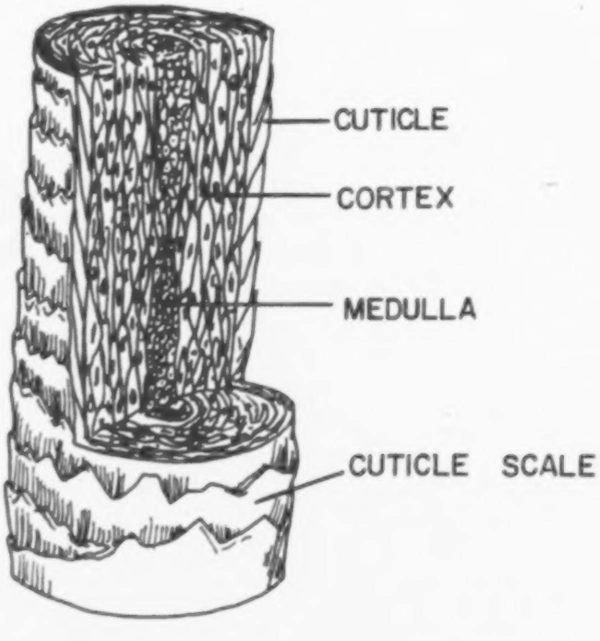
What Does It Mean?

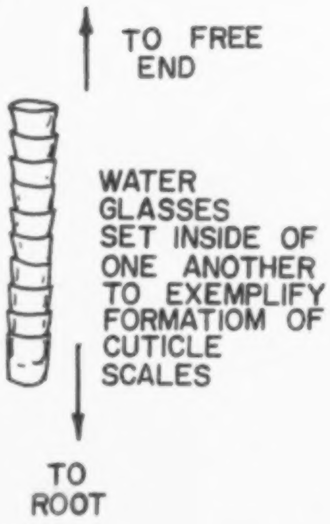
Abrasion–injury caused by rubbing or scraping
Acne–inflammation caused by collection of secretions
Acne simplex–simple, uncomplicated pimples
Acne atrophica (a-TROF-i-ka) scarring as a result of acne
Acne pustulosa (pus-chuh-LO-suh) acne with pus-filled lesions
Acute–short and severe, as an acute illness (as compared with chronic)
Albino–a person with little or no color pigment in the skin
Anidrosis–lack of perspiration
Antiperspirant–a chemical with the ability to stop perspiration
Asteatosis–lack of sebum
Benign–mild or not serious
Blister–a vesicle; an elevation of the skin
Blackhead–a plug of sebaceous matter
Blemish–a spot or mark which detracts from the physical appearance.
Bromidrosis–foul-smelling perspiration
Bulla-a large blister
Cancer–a malignant growth; skin cancer is a painful disease with much ulceration.
Chloasma–large brown patches on the skin
Chronic–long-lasting or recurring, and not too severe, as a chronic skin condition
Comedo (plural–comedones)–blackhead
Deodorize–to make free from odor
Dermatitis–any inflammation of the skin
Dermatologist–a skin specialist; a doctor who studies and treats the skin

Eruption–any visible lesion of the skin
Fever blister–skin disease consisting of inflamed vesicle. Cold sore.
Furuncle (fyoor-UNK-l)–a boil
Germinativum–deepest layer of the epidermis
Granulosum–third layer of the epidermis
Keloid–(key-loid)–a form of scar tissue that grows in excess amounts above the skin level
Cyst–a closed sac containing fluids
Keratin–a fibrous protein existing in outer - skin tissues, hair and nails
Keratoma–a callous; a thick, hard patch of epidermis
Lentigines (len-TIJ-uh-neez)–freckles
Lucidum–the clear second layer of epidermis
Miliaria rubra–prickly heat; a burning and itchy sensation.
Milium (plural–milia)–a whitehead; a small white pimple filled with sebum
Nevus (NEE-vus) a birthmark; a congenital colored area of the skin
Papillary layer–outer layer of the dermis
Papule–a small pimple
Reticular layer–the inner layer of the dermis
Sebaceous gland–oil gland of the skin
Sebum–oil from the sebaceous gland
Scale–a thin layer or covering of horny epidermis
Secretion–a substance produced by a gland
Steatoma–a fatty tumor; a cyst
Suderiferous gland–sweat gland
Stratum (STRAY-tum)–a layer of tissue, as in stratum corneum
Ulcer–open sore caused by other than an injury
Wheal–an elevation of the skin often caused by a blow or an insect bite. Not usually long - lasting.

UNIT V – THE HAIR AND SCALP

Hair is an appendage of the skin. Do you know what an appendage is? This is a way of stating that hair is an outgrowth of skin. Like nails, hair is made of the very same materials that make up the epidermis of the skin, from which it grows. Hair is made of the protein substance called keratin. The keratin in hair is a different form of the chemical as compared to the keratin in skin. Hair is slender, thread-like, and silky to the touch. It is present on all parts of the body except the lips, navel, breasts, soles, and palms. Any part of hair above the skin surface is called the hair *shaft.* Any part of hair beneath the skin surface is called the hair *root.*




TO FREE END
WATER GLASSES SET INSIDE OF ONE ANOTHER TO EXEMPLIFY FORMATIOM OF CUTICLE SCALES
TO ROOT

Structure of Hair

Do you have a microscope handy? Try putting a strand of hair under the microscope. If you look at a cross section of hair, that is, as if it were standing upright and you were looking down at its top, you would see three rings. These rings are the layers of hair. The outermost layer is called the *cuticle.* The middle layer is called the *cortex,* and the innermost layer is the *medulla.* The medulla is not present in all persons.

Cuticle

You can get an idea of the appearance of the cuticle by making a column of water glasses, one placed inside of the other, as shown above. What you see are overlapping scales. The cuticle is a horny, scaly covering which has the ability to allow substances to pass through it. When these scales are too far apart or otherwise uneven, a condition called over-porosity results.

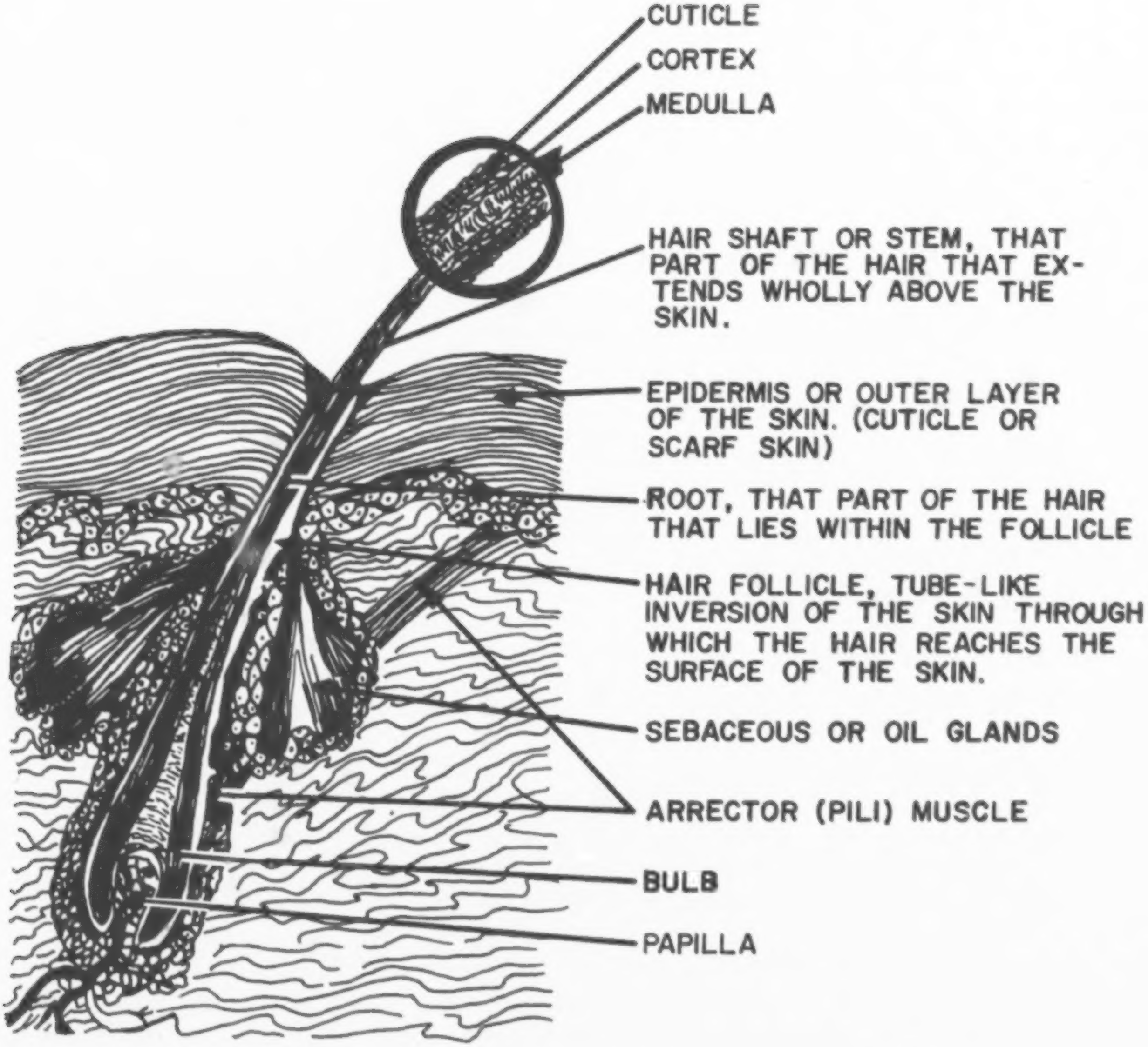
Cortex

The cells of the cortex make up the thickest layer of the hair. The substance giving color to hair–the pigment called melanin–is located in the cortex layer. The cuticle is transparent–which explains why we see the color of the cortex.

Medulla

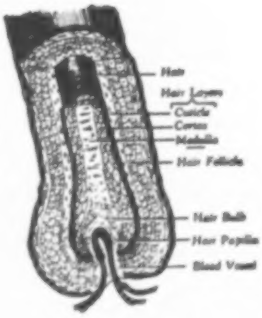
The medulla consists of granules which may be thick or thin. Since so many people who have soft, fine hair do not have medullas in their hair, there may be a connection between the medulla and the diameter of hair. However, it should be said that even hair with a wide diameter has been found to lack a medulla.

As stated before, part of the hair lies under the skin (the root), and part of the hair lies above the skin surface (the shaft). At the bottom of the root, hair becomes rounded and thicker. This round, club-like bottom to the hair root is called the hair *bulb*. **Note**–The round, white object seen when a hair is pulled out is *not* the bulb, but just a bit of material from the follicle.


CUTICLE
CORTEX
MEDULLA
HAIR SHAFT OR STEM, THAT PART OF THE HAIR THAT EXTENDS WHOLLY ABOVE THE SKIN.
EPIDERMIS OR OUTER LAYER OF THE SKIN. (CUTICLE OR SCARF SKIN)
ROOT, THAT PART OF THE HAIR THAT LIES WITHIN THE FOLLICLE
HAIR FOLLICLE, TUBE-LIKE INVERSION OF THE SKIN THROUGH WHICH THE HAIR REACHES THE SURFACE OF THE SKIN.
SEBACEOUS OR OIL GLANDS
ARRECTOR (PILI) MUSCLE
BULB
PAPILLA

A HAIR AND SURROUNDING STRUCTURES

The Structures Around the Hair



HAIR AND FOLLICLE

The hair itself fits into a pear-shaped, tube-like pocket called the hair *follicle.* Every hair has its own follicle. New hairs grow from the cells in the bottom of the follicle. As long as these cells remain alive, new hairs will replace any that die or are plucked out.

The shape of the mouth of the follicle seems to be related to the straightness or curliness of hair. For example, a follicle whose mouth (or top) is round will usually be found around a hair that is perfectly straight. But when the top of the follicle is very curved or narrow, the hair which emerges is most likely to be very curly.

Another structure underneath the root but not actually part of the hair itself is the *papilla.* The papilla is directly underneath the follicle and hair bulb. The papilla is a bit of tissue shaped like a small pencil point which fits into the bottom of the curved bulb. Each papilla contains blood vessels which feed that hair root as the hair grows. It also contains nerve endings.

HAIR PAPILLA

Attached to the hair follicle are the sebaceous glands, which contain sebum. These sacs are able to produce a substantial amount of oil daily. (Children produce less oil than adults.) The oil keeps the hair and skin soft and smooth. In addition, it tends to prevent loss of water by evaporation of sweat, thus helping to keep body temperatures normal and even.

Every hair has a tiny muscle of its own. It is attached to the hair follicle at one end and the skin at the other. The name of this muscle is *arrector pili* (uh-REK-ter pie-lie). This muscle is the smooth, involuntary type. When we get chilled or emotionally upset, the muscle contracts. This causes a minute drop of sebum to be squeezed into the follicle and at the same time causes the well-known "goose flesh" we have all experienced. The hairs stand upright and the flesh is raised in bumps.

Note—While the hair has muscle around it, there are no nerve endings present in the actual strand of hair. For this reason hair has no feeling.

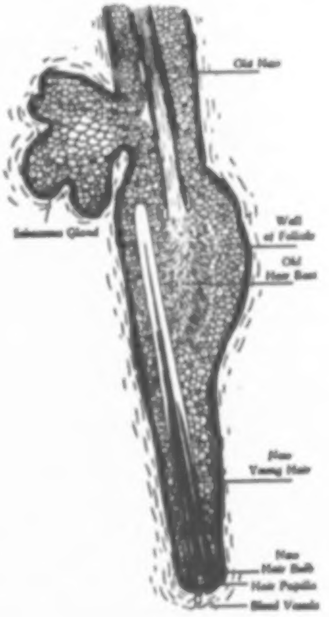
Summary

1. Hair has 3 layers: the cuticle, cortex, and medulla.
2. The bulb is the bottom portion of the hair root.
3. The root is that part of hair beneath the skin surface.
4. The shaft is that part of hair above the skin surface.
5. The following structures surround the hair: the follicle, sebaceous glands, the arrector pili muscle, and the papilla, with its blood vessels and nerve endings.

Growth of Hair

When hair grows old it is shed and replaced by new hair, which grows out of the same follicle. Not all hairs which are shed are very old. Some newer hairs will fall out for various reasons. Hair will also grow to greater lengths on certain parts of the head than it will on others. The crown and back are capable of growing 40- to 50-inch hairs, while the sides are usually limited to about 18 inches. Hair grows more quickly in summer than winter, though the reason for this is not clear. Hair also seems to grow faster between the ages of 35 and 60. On the average person, hair grows about 1 inch in 6 weeks, and short hair grows faster than hair already long.

As already stated, as long as the papilla is healthy and continues to feed the follicle, which in turn feeds the root, a new hair will always begin to grow as soon as the old hair begins to fall out. As the old hair moves up the follicle, the new hair seems to be pushing it from behind. You may not see a new hair immediately. It takes time for the new hair to form a hair shaft and break through to the surface. If all is well, this will happen.



NEW HAIR
REPLACING OLD HAIR
IN HAIR FOLLICLE

Baldness or *alopecia* (al-uh-PEE-shuh) occurs when more hairs fall out than are replaced. The cause of this is not always known, but it is known that poor health is a contributing factor.

Different Hair for Different Parts of our Body

Wherever hair exists, it is believed to be present for one important reason–that of protection. Hair in the nostrils filters out dirt, hair on the eyebrows and eyelashes protects the eyes, and the presence of hair on the head reduces the force of a blow on the head. The fact that hair also improves our appearance is an extra benefit.

There are three types of bodily hair. Hair on the scalp, beard, armpits, and groin is relatively long and soft. The eyebrows, eyelashes, and hair within the nostrils and ears are examples of short, stiff, and coarse hair. The third type of hair is called *lanugo* (la-NEW-go). This hair resembles the fuzz of a peach. Many areas of the body, including the face of a woman, have this type of hair.

The Color of Hair

We know that color pigment, or *melanin*, is present in the cortex layer of hair. If we stop to think about hair color, we might realize that there are actually only two different types of pigment–brown pigment and red pigment. Brown pigment may be very scanty (blonde),or very abundant (black). Of course there are thousands of possibilities in between. Many people have both red and brown pigment in the hair. Pigment has been compared to tiny bits of grain. When these granules are not present in hair, we say the individual is "gray." Actually there is no such color pigment as gray. Gray is simply a lack of any color pigment in the hair.

Racial Difference in Hair Types

We are fortunate to live in a multiracial society. We have the opportunity to meet many different people, and many beauty salons can boast of having operators who are skilled in performing on all types of hair. Basically we meet three racial types:

Africans or those descended from the black race,
Europeans or those descended from the white race,
Orientals or those descended from the yellow race.

The hair of the Negro, or member of the black race, is generally short and very curly. This would indicate a narrow hair follicle.

The hair of the Caucasian, or member of the white race, varies from very curly to very straight, indicating a variety of differently shaped hair follicles.

The hair of the Oriental tends to be very straight, indicating round follicles.

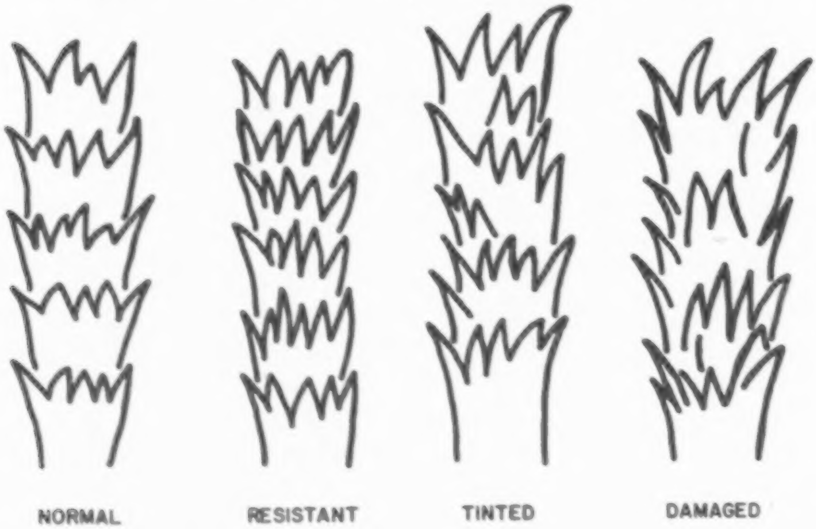
How to Analyze Hair

What kind of permanent wave should you give a patron when you have never performed on her before? How can you be expected to be familiar with her hair? How much bleaching can a particular head of hair take before the hair weakens and breaks? The answers to these and many other questions of this type is in the proper use of a hair analysis. From what you have already read, you can probably make a hair analysis right now. Let's work together:

Steps in a Hair Analysis

1. *Inspect hair TEXTURE.* Is hair coarse, fine, or medium?
2. *Determine hair ELASTICITY.* Will the hair stretch and regain its shape without breaking? This will vary from head to head, but hair should stretch as much as 50% of its natural length when it is wet.

TYPES OF HAIR AND THEIR POROSITY



3. *Judge the hair POROSITY.* Does the hair absorb a normal amount of liquid and hold on to this liquid a normal amount of time? This has a great deal to do with the cuticle of hair. If the cuticle is raised from the hair and properly spaced, the hair will absorb a good amount of moisture. Where the cuticle is not raised but clings flat to the hair strand, the hair will not permit moisture to enter. We then say the hair is not porous. Sometimes the cuticle is stretched out of shape and otherwise uneven. This is called *over- porosity.* In this case the liquid will enter, but not remain in the hair.

4. *Hair DENSITY.* Density refers to the number of hairs which exist per square inch of scalp. The head has about 1,000 hairs per square inch. Blondes usually have more hairs than brown-haired people, while brown-haired people have more hairs than red-haired people.

Gray Hair

We have already said that gray hair is the result of a lack of color pigment in the hair. If a person is born with a lack of color in the hair we say this person has congenital *canities.* "Congenital" (kun-JEN-uh-tul) means "born with," and "canities" (ka-NISH-i-eez) is the technical term for grayness of the hair.

We are not sure what makes pigment disappear in the person who has a normal color of hair. A strand of hair which already contains pigment cannot lose its pigment. When grayness ocurs, it is the new hairs that develop in the follicle that are "born" without color pigment. For this reason the graying process is a gradual one, with more new colorless hairs developing all the time. We think that heredity plays a part in this. Some scientists feel that vitamin deficiency may be important. As professionals in the field of hair care, we are fortunate to have hair products available which cover gray hairs effectively. (See Unit VIII).

Summary

1. Hair is a slender, thread-like appendage of the skin. Biologically speaking, its main function is protection.
2. Hair has three layers: the cuticle, the cortex, and the medulla.
3. The structures surrounding hair are: the follicle, the arrector pili muscle, sebaceous glands, and blood vessels.
4. The three types of bodily hair are: lanugo, long and soft, and short and stiff (bristly).
5. Hair is analyzed by judging its texture, elasticity, porosity, and density.
6. Hair receives its color from pigment in the cortex.
7. Hair differs according to the race of the individual.

Can you answer this?

1. Which layer of hair is known as the horny layer, due to its sharp edges?
2. Which layer of hair is not present in all persons?
3. Which structure determines the straightness or curliness of hair?
4. Which structure around hair causes it to "stand on end?"
5. What are the steps in a hair analysis?

6. What is meant by hair texture?
7. What is meant by hair porosity?
8. What is meant by hair elasticity?
9. Which part of the hair lies above the skin surface?
10. What is the technical term for the pigment in hair?

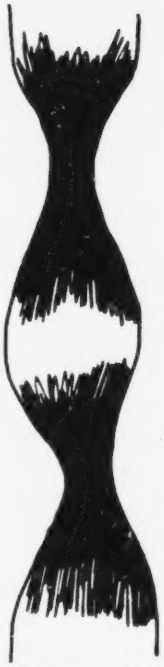
COMMON HAIR PROBLEMS

When you are a practicing hairdresser you will come across many common hair problems. We have already discussed one such problem–canities. Here are a few more problems you are going to have to deal with.

Split Hair Ends (trichoptilosis – trik-o-ti-LO-sis)

Do you recall the structure of hair? We said that the hair had three layers. If we looked at a strand of hair as if it were standing on end, we would see that the layers actually surrounded each other. What do you think would happen if one of these layers separated from the others? The hair would appear to be split. This is what happens in the condition we refer to as split ends. Split ends should be cut off or treated with hair conditioners.

SPLIT HAIR ENDS


BEADED HAIR

Beaded Hair (monilethrix–mo-NIL-e-thricks)

Beaded hair is a disease affecting the hair, but it is in no way contagious. This disease is a congenital problem, meaning the individual is born with it. It probably is inherited. The disease affects the hair follicles and will strike the entire scalp except for small areas at the back of the scalp. The hair grows to about one-half to three-quarters of an inch and then breaks off at the narrow parts between the swollen beads of hair. Medical treatment is suggested.

SERIOUS SCALP DISORDERS AND DISEASES

Dandruff (pityriasis – pity-RY-uh-sis)

It is difficult to listen to a radio or watch television without having some person asking us if we suffer from the effects of falling dandruff. If we do have this problem it is certain we know about it. These flaky white scales can easily be seen on clothing. What we are really seeing are the dead corneum cells from the scalp. This is similar to what happens to the dead cells of the rest of our body skin, but when this occurs on the scalp we call it simple dandruff, or *pityriasis simplex,* to get technical. Simple dandruff usually affects children and adolescents.

When simple dandruff becomes worse, and the scales being to collect and redness appears, we say *aggravated dandruff* is present. This type of dandruff strikes adults. It is usually accompanied by a loss of hair, leading some authorities on the subject to believe that dandruff and baldness are connected. It is possible, of course, to have simple dandruff and never get the aggravated type. When dandruff takes on a greasy coating we call it *pityriasis steatoides* (ste-uh-TOID-eez).

AGGRAVATED DANDRUFF

Scientists cannot agree on the exact cause of dandruff. Some believe that a germ is the cause, but this has not been proven. Other causes that have been suggested by various "authorities" include high blood sugar, overweight, mental strain, brain work, nervous disorders, race, occupation, and climate! This is quite a list, and you can see how much disagreement there is on the subject of the causes of dandruff. It is possible that all of these, none of these, or some of these are causes. It is also possible that the real cause is yet to be discovered.

How To Fight Dandruff

It is best to prevent dandruff before it is well established. The following rules may prove helpful in preventing dandruff.

1. Do not borrow anyone's comb, or lend your comb to anyone. (If dandruff is caused by a germ, it may be catching.)
2. Use soft water for shampooing.
3. Insist upon disposable head-rests in beauty shops, barber shops, etc.
4. Do not lean on the backs of tall seats in public places.
5. Advise affected patrons of your shop to have scalp treatments regularly.

If dandruff already exists in a serious form, a physician should be consulted. The cause may be part of a general health problem.

Loss of Hair (alopecia–al-uh-PEE-shuh)

Beauticians improve the appearance of women by improving the looks of their patrons' hair. But not everyone is fortunate to have hair. While this problem affects men more than women, many women have experienced a loss of hair. "Alopecia" is a term which means *the PROCESS of losing hair.* Alopecia does not mean baldness. The term for complete baldness is *calvities* (cal-VISH-i-eez). When a child is born without any hair, and no hair proceeds to grow due to some disorder in the follicle, we call this *congenital calvities.* When hair falls out in patches and does not replace itself in these spots, we call this *alopecia areata* (air-i-AY-tuh). As with dandruff, there are great differences of opinion as to the causes of alopecia. Among the possible causes are:

1. The malfunction of certain hormones–particularly those produced by the sex glands
2. Germs
3. Heredity
4. Certain sicknesses (syphilis, high fevers, childbirth)
5. Surgery (Major surgery upsets the body chemistry.)

Can We Cure Baldness?

We have learned that only other skin cells can produce new skin. The same is true of hair. Only a healthy follicle fed by a healthy papilla can grow hair. When these conditions do not exist, hair will not grow. This has not stopped many unusual and sometimes unhealthful and ineffective measures for fighting baldness from appearing on the market. Through loopholes in the advertising laws, these products have been able to make claims that are exaggerated or totally false.

The ancient Egyptians used a formula containing the fats of the lion, hippopotamus, crocodile, goose, serpent, and ibex. This mixture was supposed to end baldness–to say nothing of the lives of the poor animals involved. Can you imagine asking your druggist for a formula like this today? Other more serious–but just as hopeless–formulas such as tonics, lotions, creams, and salves are widely advertised today. The U.S. government has been investigating such companies with an eye toward protecting the consumer.

As with dandruff, the beginning of a hair-loss should mean a visit to a physician. There is always the possibility, however slight, that the baldness is due to a systemic condition which the doctor can treat.

SCALP DISEASES CAUSED BY PARASITES

Do you recall the definition of a parasite? We said a parasite lives off other living tissue. Following are some diseases which are caused by these tiny animals and plants.

Pediculosis (ped-ik-u-LO-sis)

This disease is caused by an animal parasite called the *louse*. Head lice most often attack children and any people who might be likely to be around children, such as teachers, nurses, etc. These parasites cause itching (due to their crawling) and burning (due to their feeding) of the skin. Often pediculosis can be detected without actually seeing the louse. The presence of the eggs (called nits) attached to the hair strands shows they are at work. Some people try to treat pediculosis by themselves. Medical treatment is suggested, however. There are several preparations available, some of which destroy both the lice and the nits. A doctor will prescribe the most suitable one.

Ringworm of the Scalp (tinea capitis–TIN-ee-uh KAP-i-tis)

Ringworm is a disease caused by a vegetable parasite. There are many different types of ringworm, some attacking non-hairy areas, and other attacking hairy portions of the skin. Any type of ringworm is called *tinea.* Tinea *capitis* means ringworm of the scalp area.

The important thing to remember about ringworm is that it is very contagious. Many hundreds of tiny fungus-type parasites can affect just one strand of hair–so you can imagine how many must be present in order to form the familiar "ring." No "worm" is present. The first symptom is a red spot. White scales or a crust may form over the spot. The spot gradually increases in size. Hair in the affected area begins to break off. Redness and scaling increase. The disease strikes children as a rule; it is believed that adults develop a kind of immunity once past puberty.

Excessive Hair or Hair Where It Is Not Normally Found

The title above is rather long, but it pretty much tells the story of *hypertrichosis* (hy-per-trik-O-sis). This disorder is very discouraging to men and women alike. It means a growth of hair on a part of the body which normally has none or a very short, fine growth, as with lanugo hair. If a man has hair on his chin it is expected, but when a woman develops a crop of hair on the chin we call this hypertrichosis. On a man, a thick growth of hair on the back and shoulders would be considered hypertrichosis. Not to confuse you, but another term often used, that means the same as hypertrichosis, is *hirsuties* (her-SU-shi-eez).

There are many ways to remove excessive or unwanted hair. Some ways are temporary, as tweezing, cutting, or with chemical depilatories. One method that is permanent is *electrolysis.* If a patron has a problem with unwanted hair, the operator must be as tactful as possible in suggesting possible solutions, as the patron is most likely very sensitive about it.

Study Aids

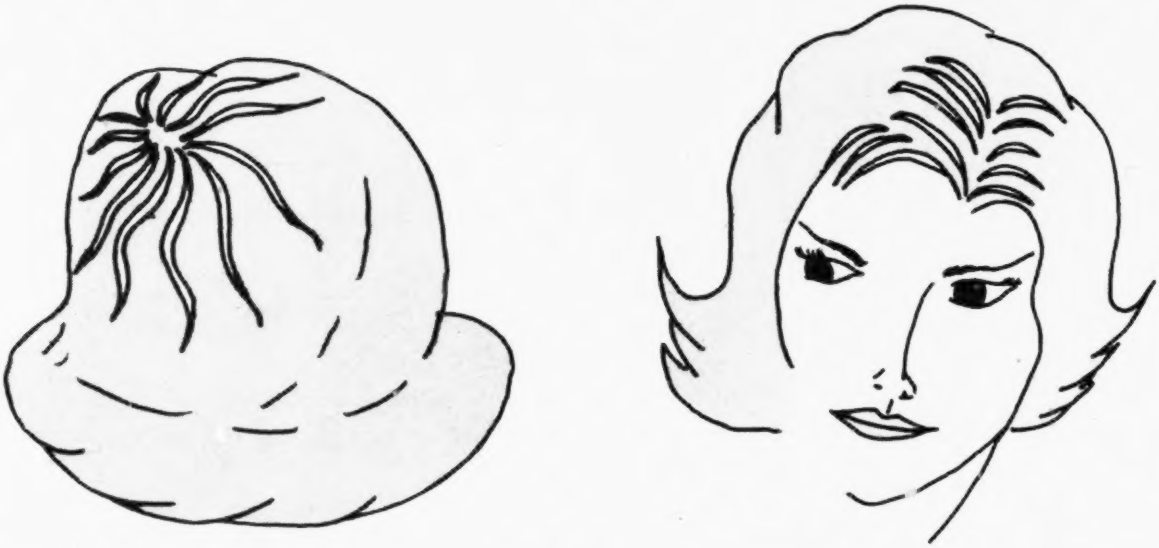
> Are you sensitive to the feelings of others? This is another chance for play-acting in the classroom. Two volunteers are needed. One student plays the role of the operator. One student plays the role of the patron with an unwanted-hair problem. If the patron is ashamed to bring up the issue but wants advice, how should the subject be handled? One very *poor* approach would be—"Madam, why don't you do something about the hair on your face?" What is wrong with this approach? The class might discuss various approaches to this problem.

GLOSSARY

What Does It Mean?

Alopecia—loss of hair
Alopecia areata—baldness in spots
Alopecia prematura—loss of hair before it is normally expected.
Canities—grayness or whiteness of hair; lack of color pigment
Congenital canities—lack of color pigment at birth, as in albinism
Cortex—the second layer of hair
Cowlick—a tuft of hair standing straight up
Hirsuties—extra hair where it is not normally found
Ingrown hair—a hair imbedded under the skin, causing possible infection

Medulla–innermost layer of hair
Melanin–the dark pigment in skin, hair, and eyes
Monilethrix–beaded hair; a condition where the hair resembles a string of beads
Pediculosis–a disease caused by the head louse
Pityriasis–dandruff
Pityriasis capitis simplex–dry, simple dandruff
Pityriasis steatoides–greasy or waxy dandruff
Scabies–a disease caused by an animal parasite called the itch-mite
Virgin hair–hair which has no permanent wave or hair dye present at the time of inspection
Whorl–a growth of hair turning around, as in a spiral
Trichoptilosis–split hair



COWLICKS

UNIT VI – THE NAIL

Do you want to earn lots of money? If you do, then don't ignore the nail and its care when you study your cosmetology assignments. Manicuring is one of the important services in the beauty salon. Before you are able to give a proper manicure, you must know the structure of the nail.

Nail, like hair, is an appendage of the skin. In fact it is made of the very same chemical ingredients as hair and epidermis. Nail is actually a thickened part of the stratum lucidum of the epidermis (the stratum corneum is missing here). Nail also consists of the protein keratin, just like hair and epidermis, except that the keratin in nail takes a harder form and therefore nail feels harder than these other parts of the body.

There is one important difference between the nail and the hair strand. Where new hairs will grow after old hairs are shed, the nail never sheds. Therefore, once the nail is lost through disease it will never grow again *unless* the matrix somehow remains in healthy condition. In general, a healthy nail appears slightly pink in color and smooth in texture.

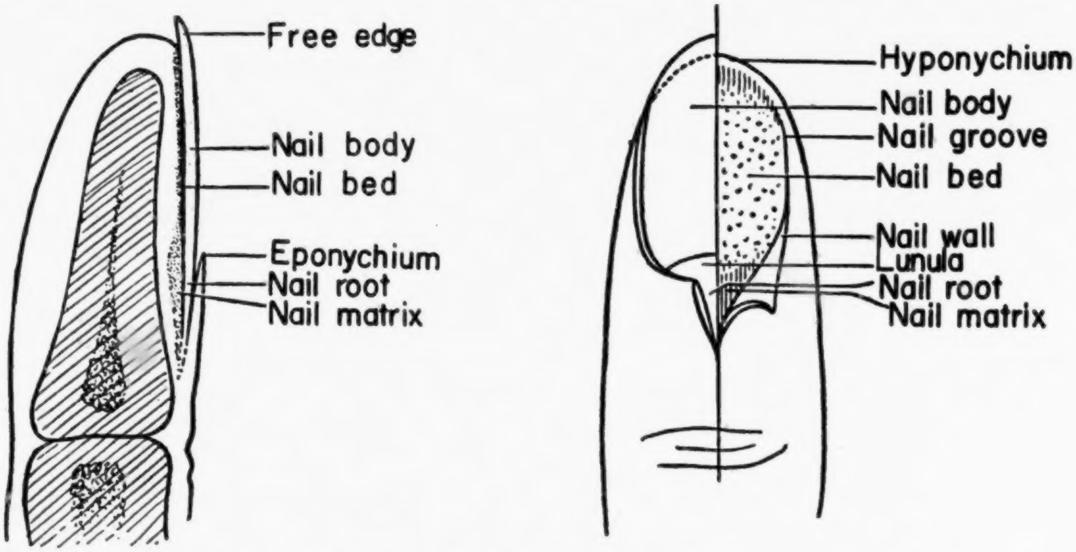


DIAGRAM OF A NAIL

Parts of the Nail. The nail itself consists of three parts:

1. The **nail body or plate**–This is the visible, hard, curved object we see on the tips of our fingers and toes.

2. Nail **root**–The covered area of nail embedded under the skin. It grows from the matrix.
3. The **free edge**–The portion of nail which grows beyond the tip of the finger.

Structures Surrounding Nail. There are many important structures which surround the nail, but are not actually a part of the nail itself.

The **Matrix** is responsible for carrying food to a growing root. As with the deep layers of the skin, the matrix is made of soft tissue. But like skin, the cells of the matrix harden and develop into the horny cells of the root.

The **nail bed** is the portion of the finger which the nail plate rests on. It includes blood vessels for continued growth of nail, plus nerve endings for the finger tip.

Lunula – This is the light-colored, curved design at the base of the nail. The nail, being transluscent (partly transparent) allows what is underneath to be seen. What we can see through the nail body is material in the nail bed, which appears to be bluish-white.

The **cuticle** is the overlapping, hardened skin around the base and sides of the nail.

The **eponychium** is the portion of the cuticle at the base of the nail, partly covering the lunula.

The **hyponychium** is the portion of skin underneath the free edge of the nail. It is not as tough as the cuticle, and is extremely sensitive.

The **perionychium** is the portion of the cuticle that surrounds the sides of the nail.

The **nail walls** are the folds of skin overlapping the sides of the nail.

The **nail grooves** are slots at the sides of the nail which the nail fits into.

The **mantle** is the heavy, thickened portion of skin which covers the nail root.

Disorders of the Nail

It is not within the range of a manicurist to treat diseases or disorders of the nail. You should, however, be able to recognize abnormal conditions. Whenever you notice any abnormal condition, you have an obligation to advise your customer as to the best procedure to follow.

Corrugations (wavy ridges) are caused by an uneven growth of the nails, usually resulting from illness.

Furrows (depressions) are due to illness or injury.

Leuconychia (white spots) are caused by bruises to the nail. The bruise to the nail causes air bubbles in the nail body. They disappear as the nail grows out.

Onychauxis (on-i-KAWK-sis) is an overgrowth of the nail. It may be corrected by filing the nail plate thin. However, it generally returns.

Onychophagy (on-i-**KOF-uh**-ji) is the technical name for nail biting. Some beauty shops will not employ nail-biters, as it is a sign of nervousness. If you are a nail-biter, you should determine to stop it now, or your career may be threatened.

Onychorrhexis (on-i-kuh-REX-is) refers to split or brittle nails. Among the causes of split nails are injury, careless filing of the nails, excessive use of cuticle solvents, and use of strong soaps or chemicals. Hot-oil manicures are recommended.

Agnails (hangnails) is a condition in which the cuticle around the nail splits. Warm oil should be used to soften the dry skin. Care must be used in cutting these hangnails, as infection may result.

Infected fingers should be referred to a physician.

Summary

1. The nail is made of keratin in a hard form.
2. The nail is an appendage of the skin.
3. The growing part of the nail is the matrix.
4. The following structures surround the nail: the matrix, the nail bed, the mantle, the nail grooves, the eponychium, the hyponchium, the perionychium, the lunula.
5. The term cuticle refers to any overlapping skin around the nail.
6. Nail is fed by blood vessels entering the matrix.
7. A healthy nail appears slightly pink and smooth in texture.
8. Many nail disorders are the result of temporary bodily conditions and disappear as the nail grows out.

Can you answer this?

1. Where does the growth of the nail begin?
2. List the structures surrounding the nail.
3. List the parts of the nail.
4. What are the names of the cuticle around the nail?
5. What is the name of the skin under the free edge?
6. Define the lunula.
7. Define the nail mantle.
8. What is the function of the nail grooves?
9. What sort of manicure would you recommend for brittle nails?
10. Can you do anything to cure hangnails?

UNIT VII – CHEMISTRY OF HAIR PRODUCTS

Introduction to Basic Chemistry

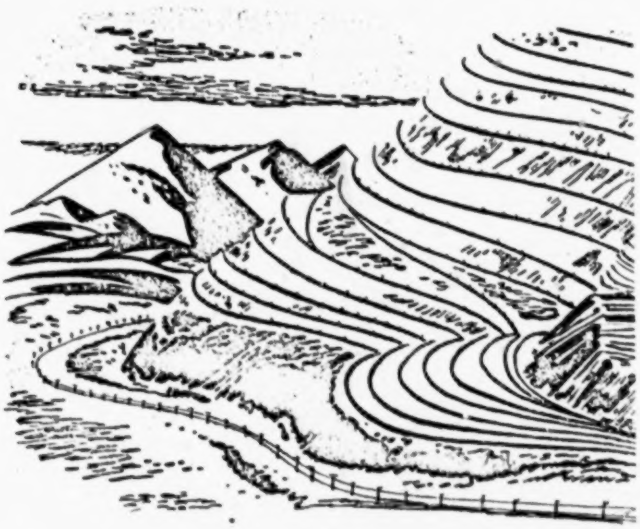
Do you like chemistry? Before you shout NO, pay attention to these simple statements:

1. Your bodies contain examples of working chemicals.
2. Everything around us consists of chemistry at work.
3. With a little practice you can turn your classroom into a tiny factory, producing your own products for your fun and amusement.

The purpose of studying basic chemistry while learning how to be cosmetologists is simply put: so that we will understand what is contained in the products we use and why certain products work better than others. Give this unit a chance, and you will find you have learned more than you realize, and all of this in a very short time. Hang on, here we go. . . .

ORGANIC

INORGANIC



AN OPEN-PIT MINE

What Is Chemistry?

To begin with, there are two kinds of chemistry–*organic* and *inorganic* chemistry. These types cover all material used in the beauty salon. As a matter of fact, organic and inorganic chemistry covers every object on the face of the earth.

Organic Chemistry

Organic chemistry is the study of things which are living or have once lived at some time in the past. For example, a horse is organic because it is living, and a wood desk is organic because it is made of wood from a tree which once lived.

Inorganic Chemistry

This type of chemistry is the study of substances which are not living and have never lived in the past. This includes anything which is *neither plant nor animal.* Rocks are inorganic. From this definition, would salt be inorganic? The answer is yes. What about a substance called *lanolin?* Before you can answer that question you have to know what lanolin comes from. If you know that it is made from sheep's wool, then you know that lanolin is organic. Are you getting the idea now? Let us move on to something called *matter.*

Matter

In chemistry this term means *anything which takes up space and has weight.* You, the chalkboard, your desk, a fleck of dust, are all examples of matter. Try a simple test to determine whether something is matter. Suppose we are not sure whether air is matter or not. Fill a balloon with air. Does the balloon get larger? If the balloon grows in size, then the air must take up space. If we had weighed the balloon on a sensitive scale before we started, and weighed it again now, we would see that the balloon weighed more now than it did before it had air in it.

We are now sure that air is matter. Suppose we are dealing with electricity? Can we fill up a balloon with electricity? No! Electricity does not take up space and have weight. The same is true of light. Light cannot inflate a balloon.

Now that we know what matter is, we must know how to recognize it. Matter comes in three forms. Matter may be a *solid, liquid, or gas.* There are many examples of this, but water is easiest to understand. When we turn our water faucet on, we see liquid pouring out. We then drink the water. But water becomes a solid at low temperatures. What is the name we give to water which becomes solid at low temperatures? "Ice" is correct. Now suppose that instead of freezing water, we heat it. What do you notice

happens to water when it is heated? Bubbles form, rise, and break open. Steam rises into the air. We call this boiling, or evaporation. Actually the water has turned into a gas called water vapor. We could turn this gas back again into water by letting it strike a cold surface. Most matter can be changed this way. For example, iron is changed to a liquid at temperatures above 2,000 degrees F. At much higher temperatures, liquid iron can change into a gas. There is gaseous iron in the sun.

How To Change the Forms of Matter

There are two ways that matter can change in form, chemically and physically.

Physical Change of Matter

When we change the form of matter without using any chemicals we say we have produced a physical change. The raising and lowering of temperatures is one way to produce such a change. We saw such a physical change in the case of water – ice – steam. Applying pressure to an object is another. Chalk is changed to chalk dust by pressing it against the chalkboard, but the material has not changed. If you could collect enough chalk dust, you could press it into a new piece of chalk.

Chemical Change of Matter

On the other hand, when we combine two substances chemically, we say we have produced a chemical change. We get a new and different substance. For example, soap is made out of animal or vegetable fats and a highly alkaline material such as a potassium or lye. When these materials are mixed and heated, they unite chemically and become a *new substance* which does not resemble any of the original parts.

Do you understand the difference between a chemical change and a physical change? Remember––one uses no chemicals to produce change, and the other brings chemicals together to make a change in form or shape. Most cosmetics are made by combining substances to produce a chemical change. OK––let's stop for a moment and sum up what we know:

Summary

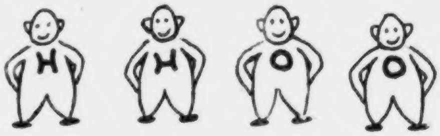
1. Chemistry has two branches, organic and inorganic.
2. Organic chemistry is the study of anything which is living or once lived. Inorganic chemistry is the study of things that have never lived.
3. Any object which takes up space and has weight is called matter. Matter can be a solid, liquid, or gas.
4. Matter can change its form. Physical change of matter can be caused by temperature change or pressure. Chemical change of matter occurs when

chemicals are mixed. Chemical changes either require heat to accomplish or else give off heat.

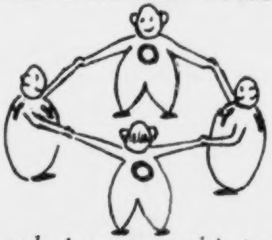
Elements and Compounds

How many letters of the alphabet are there? Twenty-six, as you know. Yet in spite of having only 26 letters, we can produce hundred of thousands of different words. How do we accomplish this? By different arrangements of these letters, of course. Nature works in the same way. We have only about 100 *elements*—the basic materials found on the earth—oxygen, iron, aluminum, hydrogen, etc. Still, with these few elements we have hundreds of thousands of different substances, made by different arrangements or combinations of these 100 elements. As an example, the element sodium is a shiny metal, and the element chlorine is a greenish, irritating gas. Yet, put together, they make something that you eat every day—sodium chloride—commonly known as table salt! So you see how completely new chemical substances may be made by combining elements.

Let us take an example from the beauty-culture field. We will use two elements, hydrogen and oxygen. Let the letter H stand for one *atom* of hydrogen, and the letter O stand for one atom of oxygen. *An atom is the smallest bit of an element,* – too small to be seen with any kind of microscope. Notice below that we have brought two atoms of hydrogen and two atoms of oxygen together.



Now let us join these atoms together by the use of *bonds.* Whenever atoms are joined, they are held together by electrical forces called bonds.



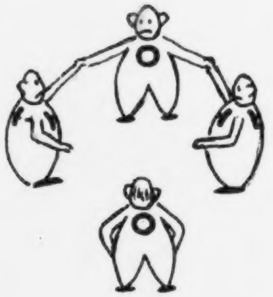
We have now created a *compound. A compound is two or more elements joined together chemically.*

Actually the compound we just created is called *hydrogen peroxide.*

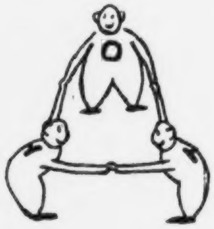
Let's take a minute out for one more definition. We have made a compound by joining two elements. Just as an *atom* is the smallest bit of an *element,* so a *molecule* (MOL-i-kyool) is the smallest bit of a *compound.* If you think about it for a minute, you will realize that a molecule must be composed of atoms.

Every molecule of hydrogen peroxide consists of two atoms of hydrogen combined with two atoms of oxygen. We can write this as a *formula*–H_2O_2. The letters stand for the elements used, and the numbers stand for the number of atoms in each molecule of the compound.

Now let's get back to our original statement, which said that elements can be rearranged. It just happens that the bond between one of the oxygen atoms and the other atoms in hydrogen peroxide is easly broken. Watch what happens when we break that bond and remove that oxygen atom.



Now look what happens to our original elements, in the next illustration . . .



Our original elements have formed a new substance. Do you know what that substance is? You are right if you say *water.* Water may be written chemically as H_2O.

We have now learned that you can produce a new substance by removing atoms, that is, breaking the bonds of the molecules of a compound and *forming new bonds* between the atoms that remain. We can also add atoms and form new bonds to make a new and completely different compound. We now must learn how to break and reform bonds.

The Breaking and Forming of Bonds

Let us bring our new understanding of chemistry closer to our study of the science of cosmetology. We have learned that we can produce a new substance by breaking down the molecules of the old substance and reforming them. How do we "break down" molecules? Fortunately we know that certain elements are particularly good at breaking down other substances for us. Hydrogen and oxygen are two such examples. By one of the laws of nature, if you add free hydrogen atoms to certain substances, the hydrogen begins to tear apart the bonds which hold the molecules of that substance together. For this reason chemists use hydrogen and oxygen (which has the same power) in their cold-wave and hair-dye preparations. When this is done, not only are bonds broken inside the solutions, but in our hair the bonds holding the molecules together are also broken. That means that we can use a chemical compound to make a certain change, and then we can easily make the change permanent with another compound (forming new bonds).

Oxidation – Reduction

When oxygen is added to a compound to break the bonds of the compound, we use the term *oxidation*. We can also say the compound is *oxidizing*.

When hydrogen is added to a compound to break the bonds of the compound, we use the term *reduction*. We can also say the compound is being *reduced*.

To put all this another way, if a substance has been oxidized, you know it has been attacked by oxygen atoms. If a substance has been reduced, you know it has been attacked by hydrogen atoms. Because of the chemical effects made possible, oxygen and hydrogen are the two most common elements used in beauty salon preparations.

Summary

1. Elements are the basic materials found on earth. They cannot be broken down into simpler substances by any chemical means.
2. Atoms are the smallest particles of elements.
3. Two or more elements joined together chemically make a compound.
4. Molecules are the smallest particles of compounds that have all the characteristics of the compounds.
5. The atoms in a molecule are held together by electrical forces called bonds.
6. Bonds can be broken and molecules reformed to make a new substance.
7. Oxygen and hydrogen atoms break bonds most easily.
8. *Oxidation* occurs when oxygen is used to break bonds.
9. *Reduction* occurs when hydrogen is used to break bonds.

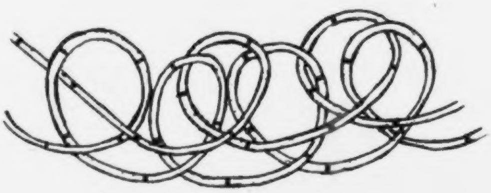
Can you answer this?

1. Explain the difference between an organic and an inorganic substance.
2. Define the term "matter."
3. What are the forms of matter?

4. Name two methods of physically changing matter.
5. Define an element.
6. Define a compound.
7. Give two examples of common compounds used in the beauty salon.
8. Explain how a new substance is formed by rearranging the atoms in a molecule.
9. Define oxidation.
10. Define reduction.

HOW COLD WAVE SOLUTIONS WORK

In order to understand cold wave solutions and how they do their work we must look at the structure of hair once more. We said that hair consisted of three layers of cells. The cortex layer, while containing color pigment, also contains the protein substance called keratin. We now can look at keratin more closely. If we can imagine a microscope powerful enough to show the individual molecules of this substance, we would see that each keratin molecule consists of a long, curled strand or fiber, with many side branches.



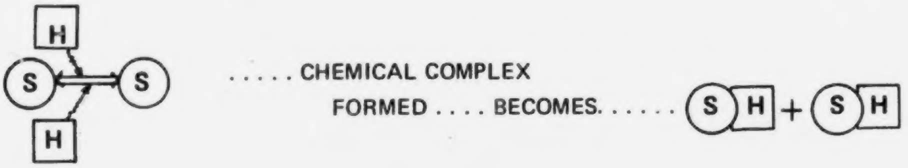
We have learned that forces called *bonds* hold the atoms in a molecule together. Keratin molecules have a great many *hydrogen* bonds, and also a smaller number of *sulfur* bonds. The sulfur bonds are much stronger, however. These bonds exist within the molecules and also between different molecules. Just where these bonds are located determines whether the hair will be straight or curly.

The objective of permanent waving is to *break the bonds* that exist in and between the molecules, and then *reform them* in other places, to give the hair the shape WE want it to have.

Now water alone will break the hydrogen bonds. We can wet the hair, roll it on rollers, and when it dries it will have the shape we want. Why is this? We have broken many hydrogen bonds with the water. Then, as the hair dries, new hydrogen bonds form as the molecules slip into new positions according to the rollers used (or pin curls or other device). But the strong sulfur bonds have not been affected. As soon as moisture reaches the hair again – a humid day will do the trick, or a slight amount of perspiration–the weak hydrogen bonds are broken again and the strong sulfur bonds take over, pulling the molecules of hair back into the shape that nature made – and there goes the hair setting.

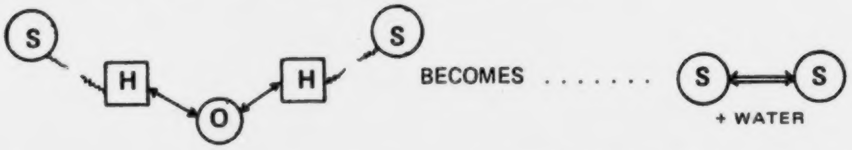
The trick is to break and reform not only the hydrogen bonds but also the strong sulfur bonds. Permanent wave chemicals enable us to do this.

In order to attack the sulfur bonds, we use the chemical fact that free hydrogen atoms will break up the sulfur bonds. (This process, you will remember, is called *reduction.*) The chemical used for this purpose is *thioglycolic acid* (thigh-o-gly-KOL-ik), often called TGA for short. It releases many free hydrogen atoms. Often this acid is combined with ammonia, and then it is called *ammonium thioglycolate* (thigh-o-GLY-kul-ate)—sometimes *thio* for short.



The chemical is left on long enough to break about half the sulfur bonds. All the hydrogen bonds have also been broken by the water in the TGA.

Suppose we removed the rods at this point – what would happen? With so many shape-giving bonds broken, the hair would just hang straight. It is also very weak at this point. Now what we must do is form new bonds within and between the molecules as they are in their new locations (according to the shape of the rods). To do this we must get those bond-breaking hydrogen atoms out. With the hair still on the rods, we now use an *oxidizing* agent to pull out the hydrogen atoms.



Now we have new sulfur bonds in new places. As soon as the water is disposed of – by drying the hair – the hair will have its "permanent" new shape. And it has regained most of its strength.

There are several different chemicals used as oxidizing agents or neutralizers. You do not have to know their names.

Since only about half the sulfur bonds are replaced with new ones, and since the new bonds are not quite as strong as the original ones, eventually the permanent will relax. Gradually the new bonds will break, and the original, stronger ones will tend to restore the original shape of the hair.

Summary:

1. The keratin in the cortex of hair consists of chains of protein materials held by bonds. There are hydrogen bonds and sulfur bonds. The bonds within and between molecules are what give hair its shape.
2. Thioglycolic acid(releasing free hydrogen) breaks down the sulfur bonds in the keratin. Water breaks the hydrogen bonds.
3. As the bonds are broken, the hair molecules take new positions according to the shape of the permanent-wave rod.
4. The neutralizer, which releases free oxygen, removes the hydrogen from the hair; new sulfur bonds form which "permanently" reharden the molecules of the hair.

Can you answer this?

1. In order to permanent-wave hair, what must be done to the chain-like molecules in the cortex?
2. Which chemical compound is used to break down the bonds in the cortex?
3. Why cannot a water-setting of hair last long?
4. What is the term we use when oxygen is applied to the chains in the hair?
5. What is the term we use when hydrogen is applied to the chains in the hair?

ACIDS, ALKALIES, AND SALTS

We have already said a compound is a chemical combination of two or more different elements. We used hydrogen peroxide and water as two examples of popular compounds. Actually all compounds (and there are thousands) fall into three main categories. These are *acids, alkalies (bases),* and *salts.* The chemical distinctions between the three types are beyond our interest here, but we can learn some things about them.

Acids

Acids are always sour to the taste. They always contain hydrogen and often contain oxygen. Strong acids like sulphuric acid can seriously burn the skin. Many mild acids occur naturally in foods, as citrus fruits, grapes, rhubarb, etc. Some hydrochloric acid is produced in the stomach.

Alkalies

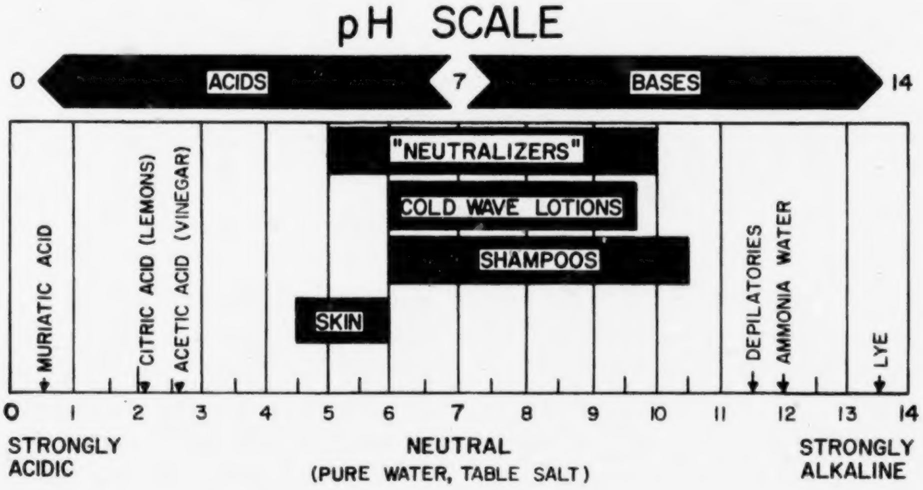
Alkalies (bases) always contain hydrogen and oxygen. Alkalies feel soapy and slippery, are bitter to the taste (not sour), and are drying to the skin. Alkalies also have cleansing power; common soaps are all alkaline.

Salts

Salts are produced when acids and bases are combined. When an acid reacts with an alkali, both a salt and water are produced. For our purposes it is not necessary to go more deeply into the study of salts.

What Is the Importance of Acids and Alkalies to the Cosmetologist?

Most of the products we use in the beauty salon are either acids or alkalies. If a product is too strongly acidic or alkaline, it can be harmful to a patron. Science has a way of measuring the degree of acidity or alkalinity in a product. This method is called the pH scale. (The letters pH stand for "potential hydrogen," but this is not important for our purposes.) The pH rating of any product can be found. While we do not have to know how to perform this measurement, it would help us to know how some products we use rate on the pH scale. Look at the chart below:



As you can see, 7 is *neutral* on the scale. The farther *above* 7 you go, the more *alkaline* a product is. The farther *below* 7 you go, the more *acid* a product is. Put another way, a cleansing compound which has a pH rating of 14 might be an effective cleanser, but it would destroy the skin.

Often the pH rating of a product is printed on the label. If this is not the case, and you would like to know if the product you are using is alkaline or acid, you can perform a test. For this test you will need a special kind of paper called litmus paper, which comes in two colors, pink and blue. The chemistry department of your school will have this paper.

EXPERIMENT

OBJECT: To determine whether a product is acid or alkaline.

MATERIALS: A product to be tested (cold wave solution, shampoo, etc.)
Pink and blue litmus paper
Glass dish

PROCEDURE: Dip a strip of blue litmus paper in your product (or a solution of your product). If the product is acid, your blue litmus paper will turn pink. (If no color change takes place, your product is alkaline.) Now dip a strand of pink litmus paper into your solution. If the pink litmus paper turn blue, the solution is an alkaline one. (If no color change takes place, the solution is acid.)

Try this test on the products you use in your school shop.

Can you answer the following questions?

1. If an acid will turn litmus paper any color at all, it will turn it_____
2. If a base will turn litmus paper any color at all, it will turn it_____

MIXTURES

How are you doing so far? In a very short period of time you have learned some of the most important facts of chemistry. Let us move on to some common terms in chemistry. Up to now we have been concerned with compounds–those combinations of different elements. We have not yet tried to mix two different compounds together. Suppose we now combine two different compounds. The result is not what you would expect. Instead of getting a new compound, we wind up with a *mixture*. This is because most compounds, when simply put together, will not break their bonds. If the bonds do not break, the compounds will remain separate–but still in the same mixture. You can say the two compounds are separate but together.

As an illustration of this, mix salt with sugar. Taste your mixture. Notice it may taste different and even appear different, but chemically no change has taken place.

In fact, if you had the patience and a good magnifying glass, you could separate the salt bits from the sugar bits, and everything would be as it was when you started. *A mixture is a combination of substances which although mixed do not break their bonds or form new bonds. In other words, they are not combined chemically. Each material in a mixture keeps its own characteristics.*

Types of Mixtures. There are several types of mixtures:

1. **Solution.** When a substance is dissolved in a liquid, the mixture is called a solution. The substance actually breaks down into separate molecules. The dissolved substance is called the *solute* (SOL-yute), and the liquid which does the dissolving is called the *solvent.* A solution is *homogeneous,* that is, uniform (the same) throughout.

   Water is one of the best solvents, as it will dissolve so many different substances. In the making of cosmetics we also use alcohol and glycerine as solvents. Alcohol is usually made from grain, and glycerine is made from fats.
2. **Colloids** (KOL-oid). These are similar to solutions but the particles do not completely dissolve. Groups of molecules are clumped together. Colloids often appear cloudy to the eye, due to the incomplete dissolving of the solute. Some colloids you have come across are egg white, paints, and puddings and gelatin desserts.
3. **Suspension.** Suspensions contain substances which will not dissolve. After stirring, the substance falls to the bottom, while the liquid above remains partly cloudy. If a label reads "shake well before using" you probably have a suspension. Household examples are calamine lotion, shoe polish, milk of magnesia. Blood is a suspension of the blood cells and other formed parts in blood plasma.
4. **Emulsion.** When two substances will not mix, we need a third substance to "get them together," so to speak. An emulsion is the result of this kind of a marriage. In an emulsion, the substances are broken up very finely and remain in suspension, at least for a while. Soap is often used as the agent to *emulsify* two substances that normally don't mix. For example, grease and water do not mix, but when soap is added, the grease is suspended in the soapy water. The mixture becomes an emulsion. Egg yolk is another commonly used emulsifier, as in mayonnaise.

Study Aids

Can you think of some common examples of emulsions used in the beauty salon? How about solutions and suspensions? Make a list of all the mixtures commonly found in the beauty salon.

The Strength of Solutions

We said a solution was part solute (say, salt) and part solvent (say, water). You no doubt have noticed that many bottles are labeled "10% solution." Ever wonder what this means? It means that 10% of whatever is in that bottle is what we want. For example, if we have a 10% cresol solution, 10% of what is in that bottle is cresol and the rest (90%) is liquid. Suppose we added more cresol and made our product a 15% solution of cresol. Would our solution be stronger or weaker? Of course it would be stronger. Can you now answer this question: Which is stronger, a 15% or a 20% solution of boric acid?

Remember: The percentage tells you how much solute the bottle contains.

Are you ready to be thrown a curve? Some labeled bottles contain not only a percentage number but a volume number as well. Hydrogen peroxide is such an example. Its label might read: 20–volume, 6% solution. We know that the 6% means 6% of the solution is what we want–namely hydrogen peroxide. Volume has to do with the amount of oxygen a solution is able to give off. For example, 20–volume peroxide is able to give off 20 volumes of oxygen; 10–volume peroxide gives off 10 volumes of oxygen. In the beauty salon we usually use a 20–volume 10% solution of hydrogen peroxide as a developer for hair-tinting products. Forty- or 50-volume peroxides contain higher amounts of solutes also, and as a result are considered unsafe to be used on the scalp.

Summary

1. There are three classes of compounds–acids, alkalies, salts.
2. The pH scale measures how acid or alkaline a certain product is.
3. A pH of 7 is neutral. A pH higher than 7 is alkaline, and a pH lower than 7 is acid.
4. There are 4 types of mixtures: solutions, colloids, emulsions, and suspensions.
5. The percentage written on the label of a product refers to the amount of solute present in the mixture. For example, 10% solution of cresol means that 10% of the mixture is cresol and the rest is water.
6. The more solute used, the stronger a mixture becomes.
7. Hydrogen peroxide is also rated by volume, which means the amount of oxygen a given quantity of peroxide can give off.

Can you answer this?

1. What are the three classes of compounds? Give a characteristic of each.
2. Explain the test for acidity or alkalinity which uses litmus paper.

3. Name 4 types of mixtures.
4. Define the term "solvent."
5. Define the term "solute."
6. If a solution in a bottle is called a 20% solution, how much of that bottle is solvent?

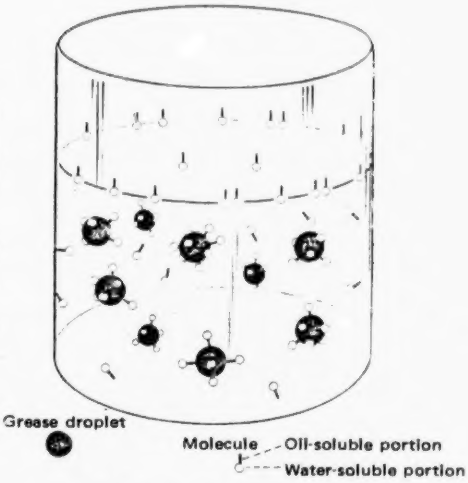
CHEMISTRY OF SOAPS AND SHAMPOOS

Before we continue our study of common beauty salon chemicals, we should take a moment out to discuss the various types of soaps and shampoos used in today's salons.

How Do Soaps Work?

Our hands, faces, and clothes get dirty from our surroundings, and this dirt gets mixed with the oils of our skin. This forms a greasy dirt, which plain water has little effect on. So we use soap.

Soap molecules are unusual in that one end of the molecule "likes" water, and the other end "likes" oil. So the soap dissolves easily in water and also *emulsifies* the grease. The grease molecules are surrounded by soap molecules, which are suspended in the water. Then they are easily washed away with more water.



HOW A SOAP OR DETERGENT WORKS

Composition of Common Soap

Basically, soap contains an alkali and a fat or oil. Alkalies can be obtained from many sources. Early American pioneers used wood ashes as alkali in the making of their soap, and beef tallow was a popular fat. Today we use sodium hydroxide (lye) in our soap products. As for fats, lard, tallow, and vegetable oils such as coconut oil and olive oil are very easy to obtain.

Do you remember the pH scale? If you do, then you will also remember this fact: The higher the pH rating, the greater the cleansing power of the product. But it is also true that the higher the pH, the more drying a product is to the skin. As professionals we should use a pH rating high enough to do the job but not so high as to injure the skin and hair of our patrons.

The Correct pH Ratings To Use in Salon Shampoos

Most common soaps range between pH ratings of 8 and 9.5. A rating of 8 is considered to be the lowest possible that will still clean effectively. Castile soap, which contains olive oil, is the mildest soap. A rating of 9.5 is considered to be as harsh as most people should use. Soaps which fall above or below these ratings usually are special products used for medicinal purposes. Soaps which have extra amounts of fats or oils added to them are called superfatted soaps. Lanolin or cocoa butter are used for this purpose. The extra oil tends to remain on the skin after rinsing and as a result keeps the skin soft. Oil shampoos have extra oils which work in the same way.

Special Soaps

Acne is a condition for which many soaps are available. Such soaps are medicated--that is, they contain antiseptic ingredients such as hexachlorophene, cresol, phenol, or alcohol. An example of a soap designed to fight acne is tincture of green soap. This soap is about one-third alcohol. Not only is alcohol antiseptic, but it also dries up excessive oils on the skin of the acne sufferer.

Many individuals have sensitive skins, and a doctor will recommend special nonallergic soaps for these people. If no such soap is available, castile soap is the safest soap to use.

Detergents

Detergents or "soapless soaps" have one big advantage over true soaps. They cleanse easily in hard water. The molecules of detergents are generally quite similar to soap molecules, but instead of being made from natural fats, detergents are manufactured by a much more complicated process, starting with raw materials from petroleum. (Commercially they are called sulfonated oil soaps.) Some detergents produce very little lather, while others produce a lot. Both clean well, but the high-lather type is likely to be more drying. A detergent is essentially neutral, neither acid nor alkaline, but other substances added to it may affect this.

Shampoos

Plain shampoos are generally solutions of soap in water. As you will see in the next section, soap and hard water together make for problems. That is why most shampoos are now made of detergents, or a combination of detergents and other ingredients.

Liquid "cream" shampoos are basically the soapless type but are likely to have some soap added as a thickener and to hold some extra oil in suspension. "Paste" shampoos have the same ingredients as liquid cream products except that there is less water and more soap or other thickener. This does not affect the cleansing power, but it enables us to scoop up the shampoo with our fingers.

Egg Shampoos

Believe it or not, you could shampoo your hair with fresh eggs, and it would prove to be a mild and refreshing treatment. However, if this is too messy for you, special products which contain eggs are available for the professional to use. A warning: Do not use very hot water with these shampoos, as the egg contained in them might "cook" and stick to the hair!

Non–Strip Shampoos

The main function of these products is to avoid removing color from tinted or toned hair during the shampoo. These products are mild, with low pH ratings.

Powder Dry Shampoos

These are made from the orris (OR-iss) root plant. The powder will cleanse the hair without the aid of water. This method is not as effective as washing.

Liquid "Dry" Shampoos

While not usually recommended for use on patrons, this type of product has proved popular in the cleaning of hair pieces. The main ingredient of this type of product is a flammable dry-cleaning fluid, which must be handled with care.

HARD WATER

No soap can do its job without the right type of water. Did you know that there are two general types of water available to us consumers? These are hard and soft water. We have already said that water contains the elements hydrogen and oxygen. If we could use water in its purest form (from the rain cloud), we would have the softest water. Unfortunately water has the ability (because it is a good solvent) to mix with and gather up certain minerals. Water gets these minerals from the ground. The most common minerals found in water are iron, magnesium, and calcium. When minerals are found in water we say we have hard water. The more minerals in water, the harder the water.

Hard water does not lather well. The minerals combine with some of the soap to form a sticky film (the "ring" around the basin), and this interferes with the cleansing action. Also, much soap is wasted in the sticky curd. The film left on the hair can be dissolved with a lemon or vinegar rinse, but for the best results in shampooing with soap we should remove these minerals from the water. We call this softening the water.

Softening water. Listed below are several methods of softening water.

1. Distillation—Water is changed to water vapor by boiling, and then condensed back to a liquid in another vessel by cooling. The minerals are left behind.
2. Chemicals—Alkaline chemicals such as borax or washing soda will soften water but they also raise the pH level, which is undesirable.
3. Zeolite tank—Zeolite is a naturally occurring mineral which has the power to attract other minerals, much as a magnet attracts bits of iron. The zeolite acts like a filter, removing minerals and leaving the water soft. While the tank holding the zeolite requires periodic maintenance, this is by far the most practical way of softening water in the beauty salon.

Summary

1. Soaps are made by combining an alkali such as caustic soda (sodium hydroxide) and a fat or a hardened oil, and heating the mixture. The higher the pH of a soap, the more cleansing it is but the more drying to the skin. The lower the pH, the milder to the skin but the less cleansing.
2. The mildest soaps are made from olive oil.
3. The stronger soaps may contain coconut oil or animal fats.
4. Superfatted soaps and oil shampoos have extra fats or oils in them.
5. Detergents or soapless soaps are compounds which are manufactured from petroleum raw materials. They do not combine with the minerals in water to form an insoluble curd. This enables them to clean effectively even in hard water. They are less alkaline than soaps.
6. Medicated, cream and paste, non-strip, and dry shampoos are special products for special problems.

Can you answer this?

1. Basically, what do all soaps consist of?
2. What pH rating might a powerful but drying soap have?

3. What is the main advantage of soapless detergents?
4. Why is hard water a problem when using soaps?
5. What do most superfatted soaps contain?
6. What is the purpose of a non-strip shampoo?
7. Name three ways to soften water. Which way is most practical for use in the beauty salon?

UNIT VIII – CHEMISTRY OF TINTS AND BLEACHES

Fortunately for the beauty profession, the use of hair coloring products by women (and men) is increasing. More and more educated hair colorists want to know how the various products accomplish their amazing color changes.

Actually there is no mystery here. What happens with tint solution when it meets with hair is the same thing that happens when neutralizer solution is applied to the hair. Our old friend oxidation takes over. Oxygen is used to break the bonds of the color pigment (melanin) so that new bonds (new color) may be deposited in the hair.

BLEACHES

You will remember that the most commonly used oxidizing agent in professional beauty work is hydrogen peroxide. Peroxide is a major ingredient in all professional commercial bleaches. Keep in mind also that oxidation occurs faster when heat is applied to the hair.

Most of you have worked with the three major types of bleaches available to beauticians–oils, creams, and powders or pastes. While taking different forms, these products all contain hydrogen peroxide.

Oil Lighteners

In addition to hydrogen peroxide, oil - type bleaches contain sulfonated oil. Oil bleaches are as a rule very mild and come in neutral (no color) or color - added products.

Cream Lighteners

These lighteners are very much like oil bleaches; they also contain sulfonated oils plus peroxide. However, they also contain a thickening agent which holds the oil and peroxide together in a creamy mixture. As a rule this type of lightener is stronger than an oil bleach, especially when a booster is added. *Boosters speed up the oxidation and cut down on bleaching time.* If you really want to impress someone with your knowledge you can tell her a booster might contain *ammonium percarbonate* (per-CAR-bon-ate) or *sodium peroxide.* A booster may be included in the bleach when it is purchased, or as an extra packet to be added acording to the manufacturer's directions. One more thing that is good to know: When a manufacturer states that his bleach has "conditioners added," he often is referring to the sulfonated oil in the product.

Powder or Paste Lighteners

Powder or paste bleaches are the most powerful lighteners on the market, due to extra boosters added to the regular oil formula. These boosters add strength but tend to dry out hair more than creams or oils.

Most lightening products are used with a separate developer. And just as you might expect—this developer is none else but hydrogen peroxide. The bleach plus the developer start an oxidizing effect on the hair right after the application of the mixture. If heat is applied with the aid of coloring machines, oxidation occurs much faster.

TINTS

Nowadays most hair coloring is done with tints rather than just bleach. A tint can work by changing the color either inside or outside the hair shaft. Those that penetrate into the hair shaft do so by spreading the scales of the cuticle.

Tints may be temporary, semi-permanent, or permanent. The temporary type coats the outside of the hair and is washed off with the next shampoo. The semi-permanent type penetrates the cuticle and lasts several weeks. The permanent tint used professionally not only penetrates the cuticle but once inside, cannot pass out through the cuticle.

The group of permanent tints and dyes includes: *aniline derivatives, vegetable products, metallic products,* and *compounds of vegetable and metallic types.* The most popular and effective products in use today are the *aniline derivatives.* These are the ones that are truly permanent.

Aniline Derivative Tints

Virtually all permanent hair coloring done in the salon uses aniline tints. These products are the most popular because of their permanent life and natural-looking colors. Once they have penetrated the cuticle layer and entered the cortex, they cannot be washed from the hair. Aniline derivative tints are synthetics made from coal-tar compounds. The most popular coal-tar product used for tint products is (and won't this surprise people) *para-phenylene-diamine* (para-FEEN-uh-leen DIE-uh-meen). This coloring agent would not do much good by itself. It must be used together with a developer. When para-phenylene-diamine is mixed with hydrogen peroxide, color molecules develop right in the solution in the jar or plastic applicator. But unless this mixture is applied to the hair immediately, the color molecules will be too large to pass through the cuticle layer. This is why it is suggested not to leave a tint solution standing once it has been mixed with a developer. When the molecules develop properly inside the cortex, they become too large to pass through the cuticle in the other direction and they remain for the life of the hair.

Aniline derivatives are sometimes called synthetics or para tints. Aniline derivatives have the following advantages:

1. A wide range of colors is available.
2. They are able to penetrate the hair shaft.
3. They are permanent (will not wash off).
4. They will not interfere with cold-wave lotion.

As with most chemicals, they have certain disadvantages also. About 10 percent of the general population have some kind of allergic reaction to them. Because of this, most states require patch tests before their use. These tints also tend to be somewhat drying to the hair.

Vegetable Dyes

These are the granddaddies of all coloring products. The ancient Egyptians are known to have used the leaves and roots of certain plants to produce a color product. In fact, Egyptian henna has been and is today the most popular of the vegetable colorings. Henna is messy to prepare and not too appealing to the eye. Once applied, henna appears off-red in color. Other vegetable dyes are saffron (yellow), sage (brown), camomile (brown), and indigo (blue). All saw some use many years ago, but with the exception of henna, none are seen today (with the possible exception of remote regions of the world).

The major disadvantages of any vegetable dye is its unnatural color and the coating method. These colorings cannot penetrate the hair; instead they coat the strand by covering the cuticle layer. Washing will not completely remove these products, and after a time of repeated use they build up in the hair. This produces a "brassy" look. Vegetable colorings are called permanent, but it is not because they penetrate—only because they build up and cannot be washed off.

Metallic Tints

Another coating-type product is made from the dyes of certain metals. Dyes made from metals are called metallic tints. Some of the more common metals used are lead, copper, and silver. The colors produced are not natural, and the products often result in hair breakage. Needless to say, you cannot perform a cold wave over hair that contains a metallic tint. While popular to some extent in 19th century America, these types of hair dyes are practically nonexistent today.

Compounds

Compound tints are combinations of vegetable and metallic dyes. Naturally, the bad characteristics of both products are still present in such a mixture. These types of dyes are not found in beauty salons today.

SEMI–PERMANENT HAIR COLORINGS

This newer type of hair-coloring product works somewhat like aniline derivative colors, since it also penetrates the cuticle layer. However, unlike the aniline product, a semi-permanent coloring does not produce any chemical changes inside the hair shaft; rather semi-permanents cover up the melanin with a special coating. As this coating is *inside the cortex* it lasts for several weeks, but as it wears off, as it must, the hair gradually regains its natural color. This may take anywhere from 3 to 8 weeks.

TEMPORARY HAIR COLORINGS

These "rinses" are not meant to penetrate the hair shaft at all. They only provide a coating to the hair. This coating is easily washed off in one regular shampooing. If by accident some of this color does penetrate the cuticle, it does not have the ability to change the natural pigment inside the cortex.

Summary

1. Oxidation is used to break color bonds and form new color bonds.
2. Bleaches are available in three forms: oil, cream, and powder or paste.
3. Oil lighteners are mildest, and powder bleaches are the most powerful.
4. Boosters speed up the oxidation of color bonds.
5. The 4 basic types of "permanent" hair colorings are: Aniline derivatives, vegetable dyes, metallic dyes, and compounds.
6. Para-phenylene-diamine is the main penetrating chemical agent used in aniline derivatives.
7. Temporary and semi-permanent colorings produce no chemical changes within the hair.
8. Some coating dyes can be permanent due to their color buildup.

Study Aids

Class– Suppose you are not sure, but you suspect that the color of your patron's hair was produced by a metallic dye. You can perform the following test to solve this problem:

THE TEST FOR METALLIC SALTS

OBJECTIVE:	To determine whether metallic dyes exist in a certain head of hair.
MATERIALS:	One glass container 20–volume peroxide 28% ammonia water a strand of hair scotch tape one eye dropper
PROCEDURE:	Mix one ounce of peroxide with 20 drops of ammonia water in a glass container. Cut strand of hair from patron's head. Bind the strand with scotch tape. Immerse strand in the solution for 30 minutes. Remove the strand and let it stand for 24 hours. Look for the following reactions:
OBSERVATIONS:	If lead is present, the hair will have changed color immediately. Often the color change is to one much lighter than the normal shade of the patron's hair. If silver is present, there should be *no* color change, since the solution cannot penetrate silver coating. If the strand has lightened, therefore, silver cannot be present. If copper is present, the solution will start to boil within a few minutes of dipping the strand in. With copper an odor is also given off, and the hair often breaks.

Can you answer this?

1. What process is used to break the bonds of the color pigment in the cortex?
2. How can oxidation be speeded up *without* the use of boosters?
3. Most bleaches can be purchased in 3 different forms. What are these forms?
4. Why are powder bleaches the most powerful types?
5. What are the 4 types of coloring products made? Which type is the most popular today?
6. What is the name of the most popular coal-tar compound used in today's tints?
7. Name two vegetable products used as coloring tints.
8. Give two examples of tints that coat the cuticle.

GLOSSARY
What Does It Mean?

Acid –a non-metal compound containing hydrogen, that turns blue litmus red. Acids have a sour taste.

Alkali–a metal compound containing hydrogen and oxygen (hydroxide). Alkalies are slippery to the touch and bitter tasting. Also called a *base*.

Aniline derivative tint–a synthetic coloring made from coal-tar products

Atom–the smallest part of an element. An atom cannot be broken down by any chemical means.

Booster–a chemical which speeds up oxidation

Base–same as alkali

Coating tint–a dye in which the color lies on the outside of the hair shaft

Colloid–mixture similar to a solution except that the particles are larger than molecules and are not completely dissolved. Will appear slightly clouded.

Compound–a chemical combination of two or more elements

Concentrated–a strong solution; one that contains large amounts of solute

Cream lightener–sulfonated oil plus peroxide plus a "thickener"; more powerful than oil lighteners

Developer–a product which helps to oxidize hair

Detergent–a cleansing agent somewhat similar to soap but less alkaline. It is made from petroleum products and is not affected by hard water. Sometimes called "soapless soap" or "sulfonated oil soap."

Dissolve–to form a solution

Distillation–a process by which a liquid is boiled off as a vapor, and then the vapor is cooled back to a liquid in another vessel. Used to obtain a pure liquid from a solution.

Emulsion–a type of mixture which contains two or more substances that ordinarily cannot be combined uniformly. The substances are broken up into very fine particles which are held in suspension with the help of an additional substance called an emulsifier.

Liquid dry shampoo–shampoos which contain flammable dry cleaning liquid. These will cleanse without the use of water.

Litmus paper–chemically treated paper which turns color to determine whether a substance is acid or alkaline

Mixture–two or more substances mixed together but not combined chemically

Molecule–the smallest particle of a compound that has all the characteristics of the compound

Matter–any substance which takes up space and has weight

Medicated soap–soap containing antiseptic ingredients to help in skin problems

Neutralizer–a compound which releases oxygen and is used to reform the sulfur bonds of keratin in the hair

Non-strip shampoos–mild shampoos with low pH ratings; shampoos which do not strip hair of color

Oxidation– the process by which oxygen unites with another substance

Para-phenylene diamine–a coal - tar compound used to make synthetic dyes

Patch test–a test to determine if a person is allergic to a particular product

Penetrating tints–chemical pigments which pass through the cuticle

pH scale–a method of measuring the degree of alkalinity or acidity in a substance. The neutral point on the scale is 7; below 7 is acid, above is alkaline.

Reduction–the removal of oxygen from a compound; the breaking down of a substance with the use of hydrogen

Solute–a dissolved substance (usually a solid dissolved in a liquid)

Solvent–a dissolving substance, usually a liquid. Water is the most common solvent known.

Vegetable tints–dyes made from the leaves or roots of plants

Zeolite tank–a tank which contains zeolite; a method of softening water in the salon by removing minerals.

UNIT IX – CHEMISTRY OF COSMETICS

When we think of cosmetics we usually think of the types of products which cleanse the skin and improve its appearance. The face, neck, hands, and hair receive by far the most cosmetic care of any parts of our body. We have already discussed the chemical forms that cosmetics may take. We know for example that most cosmetics are mixtures of some type. We also know that there are four types of mixtures: solutions, colloids, suspensions, and emulsions. Powders are somewhat different from these mixtures, since we often use a particular mineral in its powdered form as a cosmetic.

Solutions

Most lotions we use are actually solutions. Following are some of the common lotions found in the beauty salon.

LOTION	INGREDIENTS	USES
Cleansing lotion	Alcohol or sulfonated oil	For oily skin
Skin freshener lotion	Witch hazel, boric acid, perfumes, coloring, camphor	To cool and refresh skin
Acne lotion	Sulphur, glycerine, spirits of camphor, distilled water	For acne
Astringent lotion	Zinc, alum, or boric acid in a solution of water, glycerin, or alcohol	Closes pores

Suspensions

Suspensions contain insoluble powders in a liquid. Since this powder does not really dissolve, it will separate after standing for a time. Calamine lotion is such an example. Many suspensions contain zinc oxides.

Emulsions

Emulsions are what we commonly call creams. These creams contain two or more substances which are held together by a binder or *emulsifier,* such as soap or gum.

Creams are susually white in color. Below is a list of creams commonly used in the salon.

CREAM	INGREDIENTS	USES
Cold cream	Beeswax, vegetable oil, borax, water, perfume	To cleanse dry skin
Vanishing cream	Stearic acid, water, alkali, cocoa butter, lanolin, glycerin, alcohol	Leaves a protective coating on skin
Emollient cream	Waxes, lanolin, vegetable fats, oils, acids, alcohol, mineral oil	Penetrates and softens the skin
Moisturizing cream	Emollient cream plus moisturizing agents	For dry and aging skin

Powders

Powders can be in suspensions or exist by themselves. Most powders found in the beauty salon are used for makeup purposes, as face powders. Face powders usually contain zinc or magnesium stearate, or zinc oxide or kaolin, plus colorings and perfume. Powders such as this are used to smooth the skin, cover shine, and absorb perspiration.

Sticks

Sticks contain much of the same ingredients as creams except that they are poured into molds to solidify. Lipstick is such an example. Lipsticks can contain oils or waxes, to which pigment and perfume are added.

Your shop teacher can tell you of many more cosmetics used in the salon. Some come in more than one form. For example: mascara may be a liquid, a cream, or a cake. Whatever cosmetic you are using, remember, this one point: *It must be a solution or a colloid or a suspension or an emulsion.* The exceptions to this are certain powders used by themselves.

Study Aids

Now let's have some fun. Following are some recipes for making your own cosmetics. These recipes are listed in experiment form. You will be surprised how easy you will find it to make your own cosmetics right in your related cosmetology classroom. The chemistry shops in your school have most if not all of the equipment needed to perform these experiments, and the chemistry department will be happy to assist in the preparations for these experiments. Related cosmetology classrooms can have their own chemicals and equipment by simply ordering from a science catalog, available in most schools. Good luck.

Experiment
HOW TO MAKE HAND CREAM

Note: The measurements below are given in grams. It will be necessary to obtain a platform balance scale from the chemistry department of your school. If followed correctly, the suggested amounts of measured portions will produce small but adequate amounts of hand cream. If a larger amount of cream is desired, simply double (or triple) the stated amounts. The equipment below is necessary to make one or more portions.

Objective: To make hand cream

Materials:

Equipment
- Platform balance scale
- Thermometer (centigrade)
- 2 Pyrex beakers
- Glass stirring rod
- Vertical ringstand
- Pair of hand clamps or tongs
- Propane torch or bunsen burner
- Eyedropper

Chemicals		Amounts IN GRAMS
A	cetyl alcohol	0.2
	lanolin	0.1
	mineral oil	0.2
	stearic acid	1.3
B	glycerin	1.2
	methyl-hydroxybenzoate	0.02
	potassium hydroxide	0.1
	water	6.9
	perfume	one drop from eyedropper

Procedure

Each chemical in group A should be weighed and emptied into a beaker. Next weigh each chemical in group B and empty these into a different beaker. Next heat group A to 75° centigrade. When group A reaches this temperature, remove beaker from the flame and set it aside. Next heat group B to 75° C.; remove from the flame. Next add group A to group B slowly, with constant stirring. Continue stirring until the temperature of the mixture goes down to 50° C. Now add one drop of perfume from the eyedropper and continue stirring until the temperature drops to 40° C. Pour mixture into a jar. Allow to stand for a few minutes to cool. Apply cream to hands.

Experiment

Objective: To make lipstick

Materials:

Equipment
- Platform balance
- Thermometer (centigrade)
- Pyrex beaker
- Glass stirring rod
- Vertical ringstand
- Hand clamps or tongs
- Propane torch or bunsen burner
- Test tube to be used as mold

Chemicals	Amounts IN GRAMS
carnauba wax	1.0
beeswax	1.5
lanolin	0.5
cetyl alcohol	0.5
castor oil	6.5
color (vegetable type)	0.5
perfume	one drop from eyedropper

Procedure:

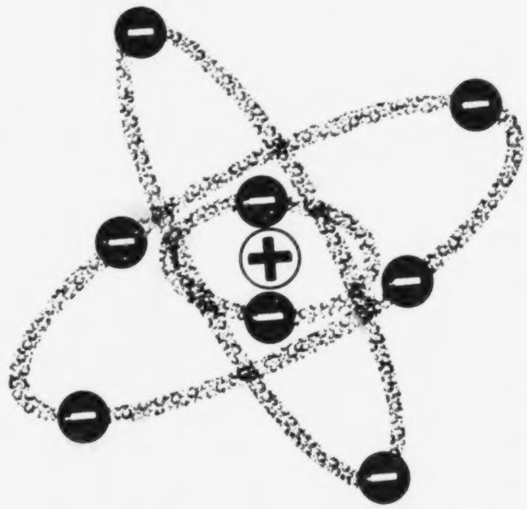
Weigh the necessary amounts and empty each ingredient into the beaker. Heat contents to 70° C. Stir vigorously with stirring rod. Pour mixture into a mold after temperature is reached. Let mixture stand until it hardens. If desired, the hardened lipstick may be removed from the mold. Apply lipstick to the hand; notice how professional it appears.

UNIT X – ELECTRICITY IN THE SALON

You are training to be a beautician and are probably wondering why a unit on electricity is included in this text. One reason is to give you a better appreciation of what makes the appliances operate. Another reason lies in the answer to this question: Do you want to be one of the best in your field? If you do reach the top of your profession, you might find yourself in a high-priced, exclusive beauty salon. This type of salon offers many special services. Among these special services are treatments for the muscles, blood circulation, and skin disorders. It could be your responsibility to give these treatments. Before we discuss this special equipment, we should have a brief but important discussion of electricity.

What is electricity? Electricity is a kind of *energy* or *power.*

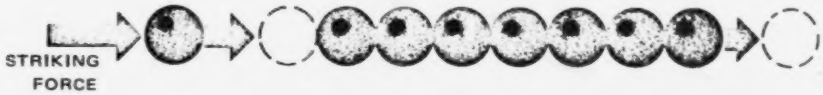
Every atom of every substance is a bundle of energy. Each atom consists of a central *nucleus* surrounded by whirling bits of energy called *electrons.* These travel at enormous speeds around the nucleus.



ONE WAY OF PICTURING AN ATOM

Some substances, particularly certain metals, have electrons that easily escape from their atoms. When these electrons move from atom to atom through wires, we have what we call a *current of electricity.* We could say, very briefly, that *an electrical current is produced by the movement of electrons.* Although any one electron, moving from atom to atom, may cover just inches per second, the electrical current itself travels at the speed of light, or 186,000 miles per second!

To try to get a better idea of how an electrical current flows almost instantaneously, set up a line of pennies as shown in the illustration here. Now knock a penny into the head of the line. What happens?



Instantly, the *last* penny is knocked away. All the other pennies move scarcely at all. Similarly, electrical current is the force produced by relatively small movements of electrons.

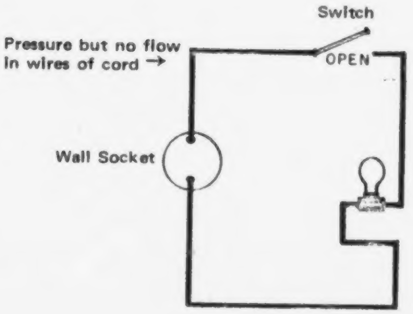
Certain materials that have electrons that escape easily are called *conductors.* All metals are conductors. Silver is the very best conductor and copper is next best. We can define conductors by saying *conductors carry electricity.* Certain materials "hold on to" all their electrons very tightly, so that it is very difficult to dislodge them. We call this type of material a nonconductor, or *INSULATOR.* Rubber, glass, and wood are some good insulators.

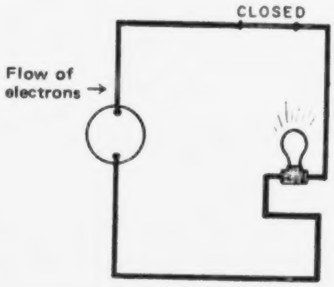
An extension cord is a double strand of copper wire, each strand covered with insulation. Suppose you have an extension cord plugged into a wall socket. Will electricity be flowing through it? No.

But suppose you have an extension cord plugged into a wall socket at one end and a light at the other end. Will electricity be flowing through it? It will flow as soon as you turn the light on.

What is the difference? For electricity to flow you need first to give the electrons a "push" – and this comes from the electricity flowing through the wires of the building. You get it through the wall socket. The "push" is called *voltage.* But you also need a *complete circuit,* that is, a pathway of conducting material that has no breaks or gaps in it. In this case, the switch on the light closes the pathway, the electrons rush along, and the light lights up.

The diagram below will help you see what is happening.





In other words, if you have a conductor attached to a source of electricity, current will flow through the wire *as soon as the circuit is completed.* If YOUR BODY is the thing that completes the circuit, the electricity will flow through YOU. (The body is a good conductor.) Depending on the strength of the electrical current, the electricity can give you a mild shock, a severe shock, or a fatal shock.

Let us get back to our electric extension cord. Without these cords, beauty salons as we know them could not function. Once we have a source of electricity and a conducting cord, we need only to attach it to an electrical machine, and the machine does the job it is meant to do. How many electrical machines can you think of that are important to the operating of a beauty salon?

Electrical Therapy

Certain electrical machines are used in body massage. We call this treatment *electrical therapy.* This type of machine has metal conductors called *electrodes* attached to them. The electrodes are held by the operator to apply electricity to the patron's body. The electrodes carry the electricity from the machine or point of origin to the body of the patron. The patron's body completes the electrical circuit, and the electricity (a very small current) flows through her body.

Wall Plates

Wall plates are a convenient way of supplying various types of currents, as described below.

Types of Current. – There are two major types of currents.

1. **Direct current** (D.C.) is a constant, straight flow of electrons which move in only one direction.
2. **Alternating current** (A.C.) is a movement of electrons that keeps reversing direction. Most alternating current produced in this county reverses its direction 120 times in a second. This is called 60 cycles, because a cycle is a reversal and a second reversal back to the original direction.

Direct Current in Massage

A direct-current therapy machine is sometimes used in addition to massage. Direct current (originally called galvanic current) is believed to produce some physical changes in the body. Some of the changes are thought to include:

1. Increase of the blood supply to a given part of body
2. Soothing of the nerves

Note–The proper application of electrical therapy in the beauty salon is dealt with in shop texts.

Alternating Current in Massage. There are two types of alternating currents used in salons.

1. "Faradic" current. This weak A-C current is believed to improve muscle tone and increase the activity of the sweat glands. Of course you cannot use A-C as it comes from an ordinary outlet for this – you might kill your patron!
2. High-frequency current. This is weak 60-cycle current stepped up by a machine to much higher frequency. This can
    - a. provide soothing heat treatments
    - b. provide soothing relief to muscle ache

IMPORTANT!

Whether or not we ever use electricity in conjunction with massage, we all use it daily in our shop work. Our first concern as professional cosmetologists is the safety of our patrons. Always be on the lookout for:

1. loose or worn-out wires;
2. bad connections or broken plugs;
3. any improper functioning of a machine.

Report them immediately.

One more point. WATER is a good conductor of electricity. No electrical device should be used near water. Many fatal accidents have occurred when a small machine or radio fell into water, or when a person was standing on a wet concrete floor and accidentally became part of an electrical circuit. Remember– Keep all electrical appliances away from water. And do not handle electrical things with wet hands.

Study Aids

Class–Students might make lists of all electrical equipment used in salons. A short description of each appliance and its uses should be given. Remember–anything that runs on electricity and is used to help us perform direct beauty work on the patron should be included in your discussions. Include such objects as vibrators, vaporizers, heating caps, dryers, electrodes, wall plates, etc.

Can you answer this?

1. Define the term "current".
2. Define the term "direct current."
3. Define "alternating current."
4. Where does the electricity in a salon come from and how do you get it to do work for you?

5. What 3 things are necessary if a current is to flow?
6. Give 2 examples of good conductors.
7. When a patron is undergoing electrical therapy, why isn't she severely shocked by the electricity?
8. All electrical appliances should be kept away from __________.

Static Electricity

Have you ever combed or brushed a clean, dry head of hair so vigorously that the hairs flew apart by themselves and stood out from the head?

Have you ever walked across a deep-pile rug on a dry day and received a shock when you turned on a light?

Have you ever slid across the seat of a car and received a shock when you touched the metal door handle?

All of these peculiar things happen because of electricity, but a different kind of electricity. We call this static electricity ("static" meaning "standing" or "at rest") as distinct from current electricity ("current" meaning "flowing.") Actually, static electricity was discovered long before scientists learned how to produce current electricity.

As we said before, all matter consists of atoms, with electrons whirling about the central nucleus. The outer electrons of many substances are easily displaced. The rug we may be walking across has so many billions of atoms in it that you could not possibly imagine a number that large. Walking across the rug, your shoes may rub off a few million electrons. These are now part of YOU, but they just stay on you, because they have no place to go. You are not part of any circuit. But your own body is no longer electrically *neutral*. With all those extra electrons, you now have a *charge*.

When you get to the light switch, the electrons have found a place to go, for the wires behind the switch are conductors that will permit the electrons to flow to the earth. The electrons jump the gap between your fingers and the switch, and you get a shock.

Or the comb going through the dry hair will take electrons from the hairs. It will get a charge because it has extra electrons. The hairs will also get a charge because they have *lost* electrons. (A shortage of electrons also produces a charge.) The hairs are all charged alike. They repel (push away from) each other – and stand away from the head.

There are many other signs of static electricity you often come across. *Opposite* electrical charges can make things cling together, just as *like* charges make them push apart. The slip that "rides up," the papers that cling together, the hair that you've picked up and now can't seem to get off your finger – these are all examples of electrical charges. Whenever you experience peculiar things like these – and many others – you can be pretty sure that your old friends the electrons have collected somewhere and nature is trying to even things out.

EXPERIMENT

Objective: To electrically charge a comb

Materials:

hard rubber comb
table - tennis ball
piece of woolen cloth

Procedure: Rub the comb vigorously with the woolen cloth. The comb is now electrically charged, since it has picked up extra electrons from the woolen cloth. Now bring the comb near a table - tennis ball lying on a desk or table. Notice the ball roll to the comb. Keep moving the comb ahead of the ball, and the ball will follow until it rolls off the table.

UNIT XI – LIGHT IN THE SALON

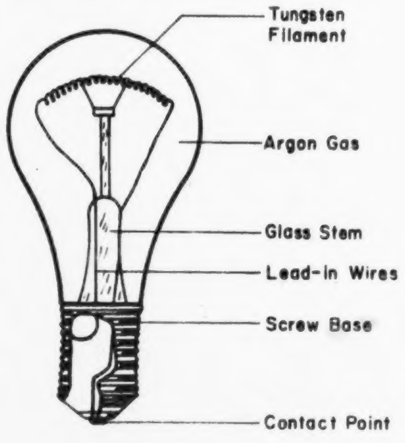
Introduction

If you thought chemistry and electricity were "far out," what will you say when you are told that you can use *light* to improve the physical appearance of your patrons? You read this correctly. You will use two kinds of light that are actually a part of sunlight–but they are the parts we *don't see!* Light whether natural or man-made, can do a great deal for the physical and psychological well-being of your patrons. In addition to these advantages, light treatments with the use of special therapeutic (treatment) lamps have become excellent sources of income to the progressive beautician.

What Is Light?

Have you ever thrown a pebble into a pond? If you have, then you have seen the water rippling out in small circular waves. Light travels in much the same way–out in all directions from the source, in *waves of energy*. Light waves not only make it possible for us to see the world around us, but some of them can also produce changes in the human body. If light seems even more difficult to understand than electricity, you will be relieved to know that scientists are still working to solve the problem of just what light is.

Naturally, light waves must have a source–that is, a place where they begin. The source of light is usually a material that is *incandescent* (in-can-DES-int). This means an object which is so hot it actually glows (like the sun). The glow is called LIGHT. For centuries the only light man had was sunlight. Today we produce artificial light in several different ways. We have fluorescent, neon, and other vapor-type lamps, as well as the incandescent ones. The ordinary electric light we are so familiar with glows due to the *heating* of the filament inside the bulb. Electricity is passed through the ultra-thin filament, which then becomes so hot that it glows. The filament is preserved for long periods by pulling the air out of the bulb so that the filament does not burn up or oxidize. The other types of bulbs owe their light to the action of electrons, which bombard certain gases inside the bulb.

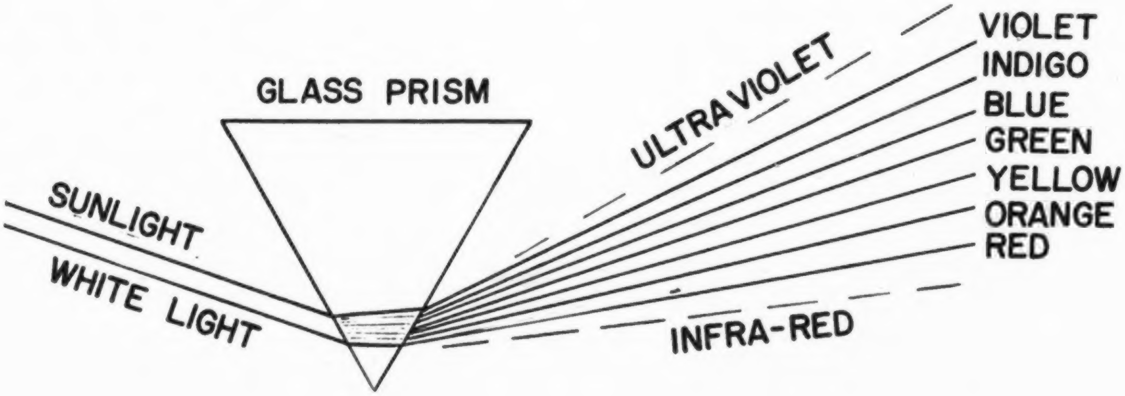


The incandescent electric lamp

Waves of light travel at enormous speeds. We know that light from the sun goes 186,000 miles per second. The sun is 93 million miles away, yet its light takes only 8 minutes to reach us.

Color

It's hard to believe, but the white light coming to us from the sun is actually a mixture of many colors. Would you like to prove that sunlight contains many colors? Borrow a triangular glass prism from the science department of your school. Hold the prism up to the natural light and allow a narrow beam of light to pass through it and be thrown on a white screen. You will see a continuous band of color that we call the color *spectrum.*



White light is broken up by a prism into the color spectrum.

You've seen that spectrum many times—in the sky after a shower. You called it a rainbow.

The colors of the spectrum are violet, indigo, blue, green, yellow, orange, and red in that order. (You can remember the colors of the spectrum by the first letter of each word—VIBGYOR. Or some people prefer ROY-G-BIV.) These colors blend gradually into each other, so that there are actually thousands of colors in the spectrum. The colors that are visible to us are called the visible part of the spectrum.

Without the visible colors of light we could not tell the color of any object around us. Here is the way it works: An object may be either opaque (o-PAKE) or transparent. Most things, of course, are opaque, which means we cannot see through them. An opaque object reflects some of the light that falls on it and absorbs the rest. A greeen piece of clothing absorbs all the visible colors in the spectrum except green, which it reflects to our eye. A red sweater absorbs all the visible colors except red and reflects this red to our eye. In other words, the color that we see is actually the color that an object does not absorb and therefore reflects to our eye. Without light there can be no color. A red object in a dark corner looks black.

Transparent objects are somewhat different. Their color depends on the color of light they transmit (send through). However, transparent objects have little application in the beauty salon.

We said that the color of an object depends upon which portion of the spectrum it reflects. We assumed that the light it was viewed by was white light, containing all the colors. Now suppose we viewed the red sweater by red light. It would reflect the red light and would still look red. But suppose we viewed it in green light (say, through a green window). There is no red light in green light to reflect, so the sweater would absorb all the light, and it would look black. Now suppose we viewed it in orange light. The colors all overlap, you know, and there would be some red in the orange light, so the sweater would still look red. Even under yellow or purple light, there would be some red in the light, and we would see red, with perhaps a little yellowish or purplish hue.

This leads us to an interesting topic–the use of lighting to bring out the colors we want to bring out. When the first fluorescent lights were made, they gave out a very bluish light. Many still do. As a result, the blue in a person's features was reflected out of proportion and hence accented–the shadows under the eyes, for example, or veins close to the skin surface. As a result, most people looked rather unattractive under these lights. Nowadays fluorescent lights are available in "warmer" colors, to more nearly approach the color of natural light, and we look better. A salon that wants to flatter its patrons will see to it that there is plenty of warm incandescent light around, even if, for efficiency's sake, most lighting is fluorescent.

Not all the colors of the spectrum can be seen, however.

The Invisible Spectrum

On either side of the spectrum are waves of light that do not affect our eyes and therefore are invisible. These are *infra-red* and *ultraviolet* rays of light.

Infra-Red

The infra-red rays of the sun have the power to penetrate deep into the body tissues. Infra-red light is not seen, but the heat that accompanies it can always be felt. Since it is not practical for us to sit patrons in the sun for long periods of time, we use infra-red lamps, which produce light rays very similar to what the sun produces. Infra-red lamps have the following effects on the body:

1. Speed up body production of perspiration and oils for the skin.
2. Increase blood circulation.
3. Relieve muscular aches by heating the area.

Your shop teacher will familiarize you with the use of infra-red lamps and explain the safety precautions you must take in using them.

Ultraviolet

At the other end of the spectrum is another type of invisible ray coming from the sun. These rays are called ultraviolet rays. Ultraviolet rays must be used with even more care than infra-red rays, so as not to burn the patron. The closer we place an ultraviolet lamp, the more ultraviolet rays reach the patron, and the more dangerous the lamp becomes. If we hold the ultraviolet back farther, fewer ultraviolet rays reach the body. This type of light has the following effects on the body:

1. Provides vitamin D for the body, and hence
2. Helps the body absorb and use calcium and phosphorus, to keep bones in good condition.
3. Tans the skin.
4. Helps promote healing of acne, tinea, seborrhea, and dandruff.

Great care should be taken when these lamps are applied to the body. In general this type of lamp should not be held closer than 30 to 36 inches away from the skin. Treatments may be two minutes long at the start, and increase to 6 to 8 minutes after a time. The cosmetologist and patron must wear eye goggles to protect their eyes.

Types of Lamps

In cosmetology, any electrical device which produces light rays is called a *therapeutic* lamp, that is, a lamp designed to treat a health problem. These lamps use different types of bulbs. The main types of bulbs are the glass bulb, the cold quartz bulb, and the hot quartz bulb.

The Cold Quartz Bulb

This bulb comes in several different shapes. Because it is capable of producing very short ultraviolet rays, it is used mostly by hospitals.

The Hot Quartz Bulb

This lamp is most often used for its germicidal (germ–killing) effects. Its ultraviolet rays are helpful in treating acne and other skin disorders.

The Glass Bulb

This large bulb is used mainly for tanning.

Visible Light Bulbs

Bulbs giving off visible light also have some small effects on the body, as well as providing relaxation and a sense of well being. Ordinary colored bulbs giving off red or blue colors fall in this group. The blue bulb has weak germicidal effects, due to a small amount of ultraviolet given off; it is usually used on bare skin. The red bulb will produce mild heat rays, which are very relaxing.

Can you answer this?

1. Name the colors of the spectrum.
2. What determines the color of an opaque object?
3. What types of light bulbs are most flattering to most people?
4. What are two types of invisible rays given off by the sun?
5. Give two benefits of treatment with ultraviolet rays.
6. Give two benefits of infra–red light on the body.
7. Which type of bulb is used for tanning?
8. Which type of bulb is generally used in hospitals?
9. Why should invisible - light bulbs be used with great care?